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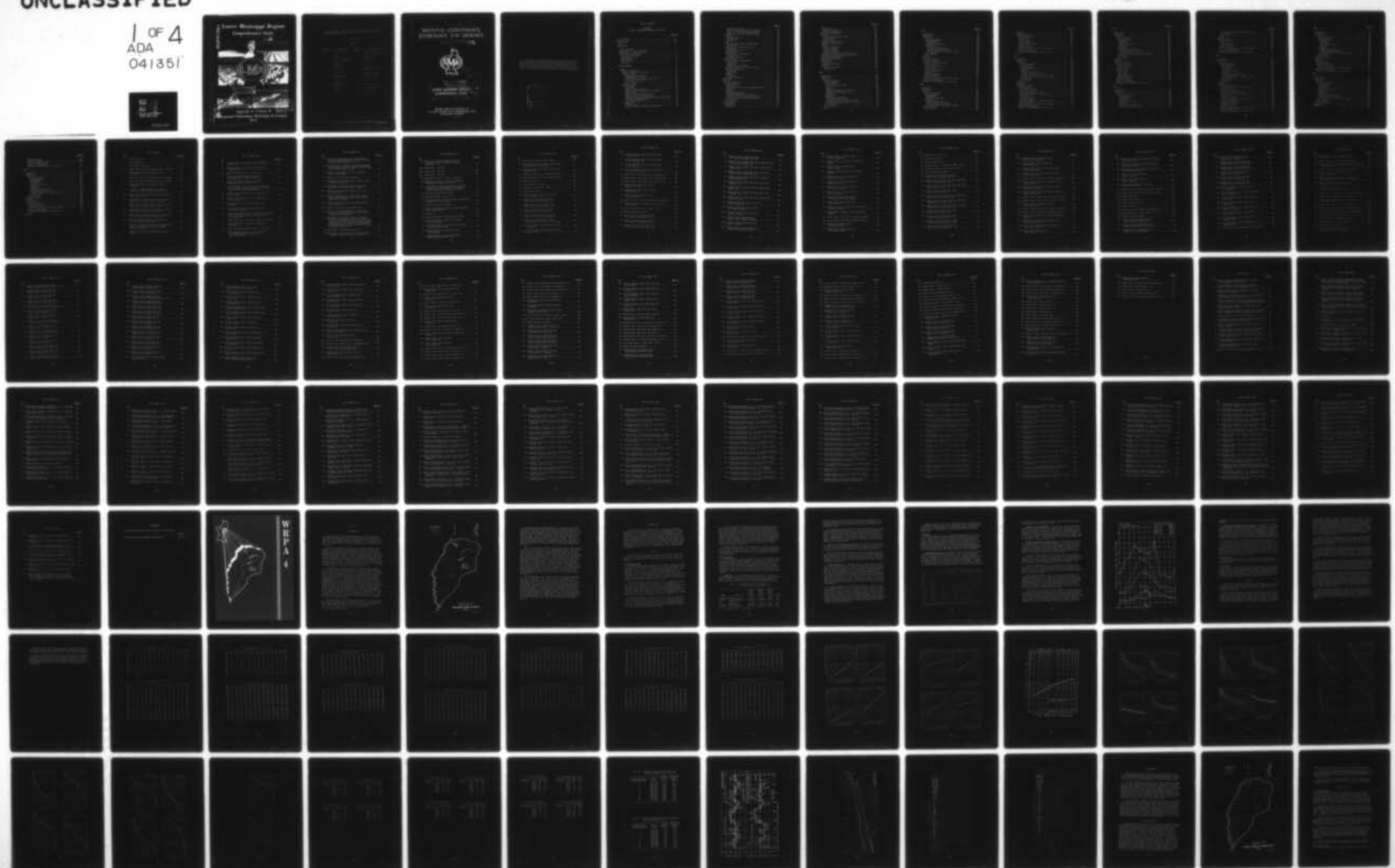

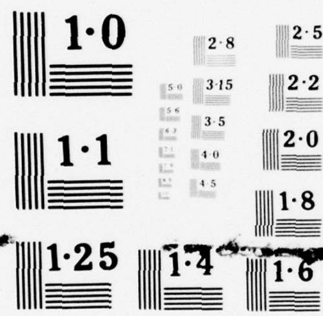

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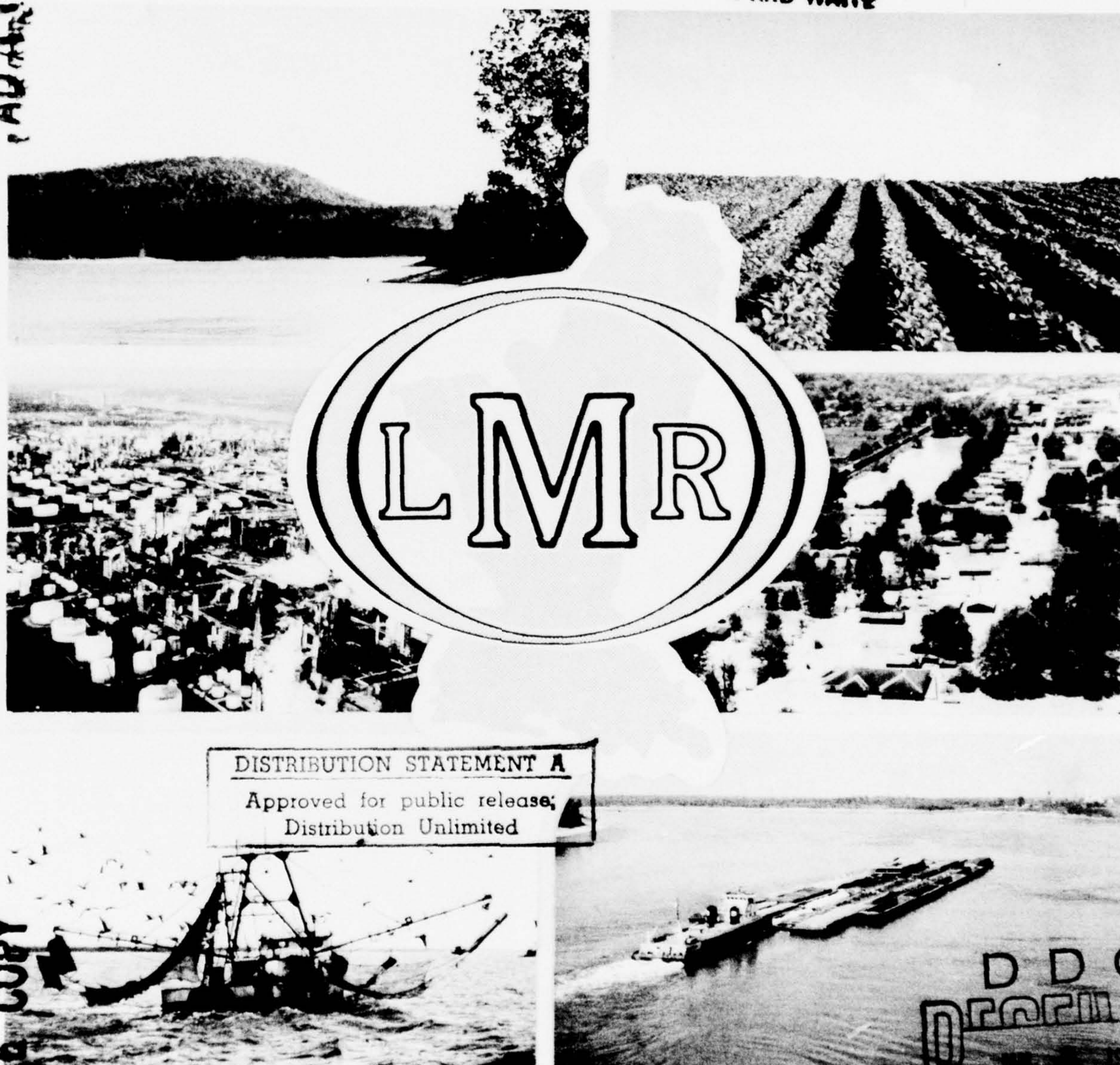
Lower Mississippi Region

Comprehensive Study



Appendix C, Volume II

Regional Climatology Hydrology & Geology

1974

This appendix is one of a series of 22 documents comprising the complete Lower Mississippi Region Comprehensive Study. A list of the documents is shown below.

Main Report

Appendixes

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B	Economics	L	Water Quality and Pollution
C	Regional Climatology Hydrology & Geology	M	Health Aspects
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REGIONAL CLIMATOLOGY, HYDROLOGY AND GEOLOGY.

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1974

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LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY.

Appendix C, Volume II.

PREPARED UNDER THE SUPERVISION OF
THE LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY
COORDINATING COMMITTEE

410 262

This report was prepared at field level by the Lower Mississippi Region Comprehensive Study Coordinating Committee and is subject to review by interested Federal agencies at the departmental level, by Governors of the affected States, and by the Water Resources Council prior to its transmittal to the President of the United States for his review and ultimate transmittal to the Congress for its consideration.

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PHOTOGRAPHS

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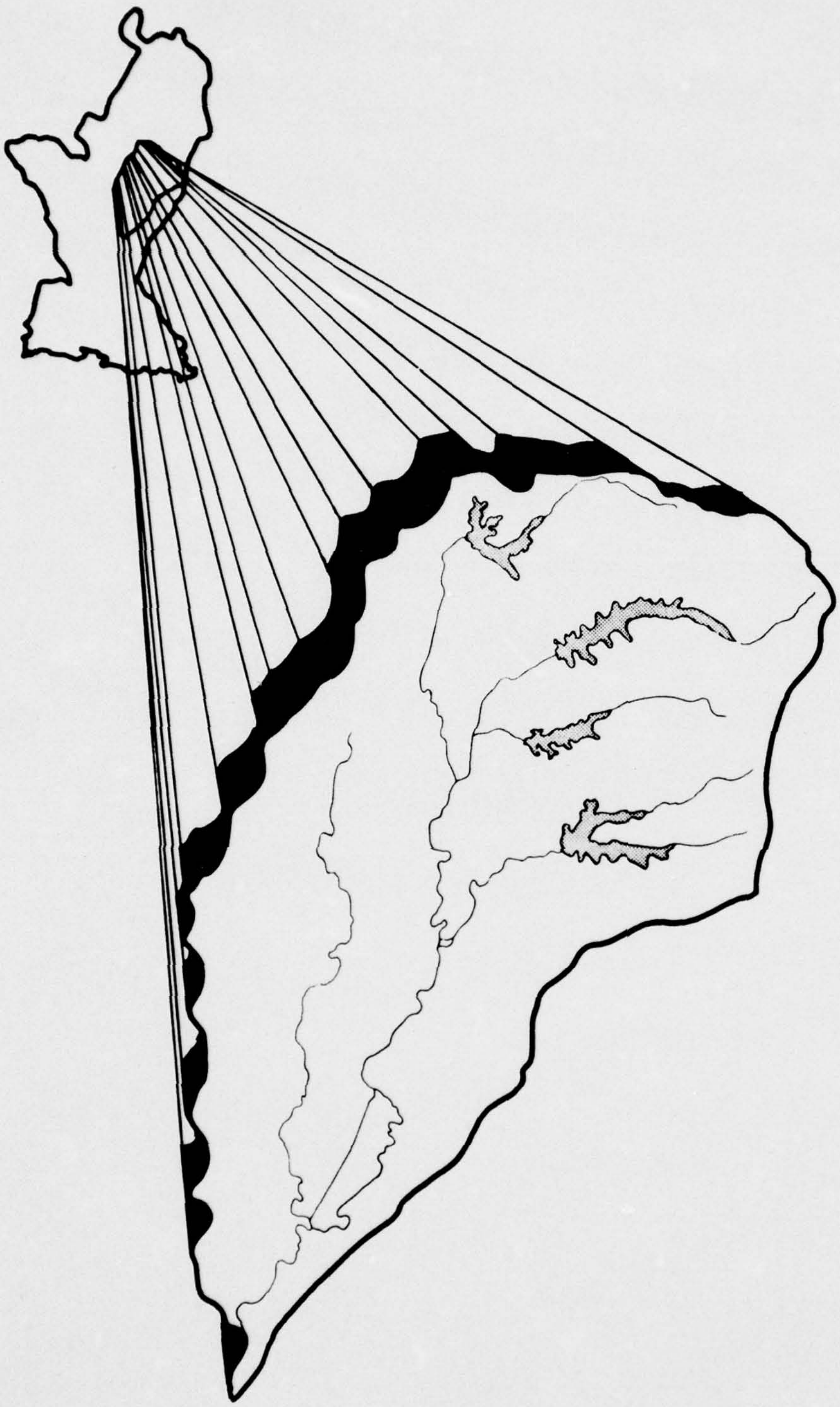

W R P A 4

W R P A 4

INTRODUCTION

WRPA 4 consists of the entire drainage area of the Yazoo River Basin and lies totally within the State of Mississippi. The area is composed of 13,355 square miles, or 13 percent of the total area of the Lower Mississippi Region. About 323 square miles, or 2 percent of the area, are covered with water and the remaining 13,032 square miles are land areas.

The area is bounded on the north by the northern boundary of the Coldwater and Tippah River watersheds, on the south by the northern boundary of the Big Black River watershed, on the east by the western boundary of the Tombigbee River watershed, and on the west by the east bank Mississippi River levees. The area is about 200 miles in length with a maximum width of about 110 miles. No drainage enters WRPA 4 from the other planning areas, and all the drainage which originates within the area eventually passes through the main stem of the Coldwater, Tallahatchie, and Yazoo River system to the Mississippi River. These major stream patterns, along with the WRPA boundaries, major cities, and other pertinent features of the area are shown in figure 173.

The Coldwater, Little Tallahatchie, Yocona, and Yalobusha Rivers rise in the hill areas of north-central Mississippi and flow southwesterly to form or join the main stem of the Yazoo River system. The main stream comprises the lower 46 miles of the Coldwater River from Prichard, Miss., by way of Pompey Ditch, to its confluence with Little Tallahatchie River at Panola-Quitman Floodway; thence, 84 miles through the Tallahatchie River to its confluence with the Yalobusha River above Greenwood, Miss. This confluence forms the Yazoo River, which flows southwesterly through the delta about 169 miles, with some of the flow being conveyed by the Whittington Auxiliary Channel, to discharge into the Mississippi River at Vicksburg, Miss. (mile 437.6 AHP 1/). The main channel is deeply entrenched throughout its length with bank heights ranging from 30 to 45 feet, respectively, at Greenwood and Satartia, Miss. Channel widths range from 300 to 500 feet. The river is a relatively stable stream with fairly flat slopes and low velocities. Average water surface slopes on the main channel vary from 0.2 to 0.3 foot per mile, with an average velocity of 3 feet per second and a maximum velocity of 5 feet per second.

Stream gradients of tributary streams in WRPA 4 vary significantly due to the two distinct types of terrain in the area. In the hill area, the average stream gradient is 1.5 feet per mile, and slopes of the delta area streams vary from 0.25 to 0.5 foot per mile.

1/ AHP - Above head of passes.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

MEAN ANNUAL RUNOFF IN INCHES

WRPA 4

FIGURE 173

Topography of the area varies greatly. The delta areas are composed of low flatlands in the alluvial valley of the Mississippi River. Elevations in this area range from about 200 feet near Tunica, Miss., to about 90 feet near Vicksburg, Miss. An abrupt bluff hill line rises on the east side of the delta with sudden rises of more than 100 feet in some locations. All of this area consists of rolling to rugged hill land with valleys ranging from 1/2 to 2 miles in width. Soils in this area are principally loessial silts underlain by terrace sands and gravels and tertiary deposits. Elevations in the hills reach 640 feet near New Albany, Miss., and range from 300 to 500 feet throughout the hill area.

WRPA 4 can be divided into two distinct areas based on the characteristics of flow in the area. The Yazoo backwater area is that part of the area which lies between the east bank Mississippi River levee and the hills, and is subject to backwater flooding from the Mississippi River through the opening between the end of the main line levee and the hills just north of Vicksburg, Miss. The backwater area is composed of about 1,550 square miles of typical alluvial valley lands which extend northward from Vicksburg about 60 miles to the vicinity of Belzoni, Miss. [124]. Drainage of about 4,100 square miles of alluvial land located west of the Yazoo River is provided through the Big Sunflower River and Steele Bayou into the Yazoo River [125]. The backwater area east of the Yazoo River consists of 271 square miles of delta areas and nonoverflowing hill areas which drain through the delta area and into the Yazoo River via small streams and creeks. The remainder of the Yazoo-Tallahatchie-Coldwater River drainage basin is called the Yazoo headwater area.

The Yazoo headwater area is that portion of the Yazoo River drainage area above Belzoni, Miss., which is subject to headwater flooding. The area is composed of 2,300 square miles of alluvial lands and 6,600 square miles of rolling and rugged hill land [120]. The Yazoo, Tallahatchie, and Coldwater Rivers provide the major drainage outlets for the area. The Little Tallahatchie, Yocona, and Yalobusha Rivers are the principal hill tributaries; and Cassidy Bayou is the principal delta area tributary in the headwater area. There are four flood-control dams located on the tributary streams in the hill areas which are collectively capable of impounding more than 3.8 million acre-feet of water at the flood-control pool [120]. These dams form Grenada Lake on the Yalobusha River, Enid Lake on the Yocona River, Sardis Lake on the Little Tallahatchie River, and Arkabutla Lake on the Coldwater River.

SURFACE WATER

The majority of the streamflow which is generated within WRPA 4 originates in the tributary basins in the Yazoo headwater area. Major tributaries are the Yalobusha, Yocona, Little Tallahatchie, and Coldwater Rivers. The sequence of flows discharged from each of these respective streams is controlled by the operation of the Grenada, Enid, Sardis, and Arkabutla Dams. These dams control about 60 percent of the total drainage area of the Yazoo River at Greenwood, Miss.; hence, daily flows for stations at and above Greenwood are greatly affected by short-term changes in release rates at the reservoirs [122]. Average annual discharges, however, give a true representation of the surface runoff for the area.

Quantity

The average annual discharge of streams originating in WRPA 4 is 17,670 c.f.s. This is equivalent to about 1.3 c.f.s. per square mile, which is an average figure as compared with that for the rest of the region.

Present Utilization

Withdrawals from surface water sources in WRPA 4 during 1970 (about 730 c.f.s.) were equivalent to about 4 percent of the mean annual flow generated in the area. This constituted about 55 percent of the area's total water use of 1,355 c.f.s., with the remaining 45 percent (625 c.f.s.) coming from ground water sources. Major surface water withdrawals were for purposes of power production (425 c.f.s.) and irrigation (195 c.f.s.), which composed 58 and 27 percent, respectively, of the total surface water withdrawn. About 8 percent of the surface water withdrawn was for industrial purposes (58 c.f.s.).

Major withdrawals of ground water were for the purposes of irrigation (267 c.f.s.), commercial fishing (88 c.f.s.), municipal uses (83 c.f.s.), and industrial uses (76 c.f.s.). All of the water used for municipal water supply in the area was withdrawn from ground water sources. During 1970, about 590 c.f.s., or 44 percent of the total surface and ground water withdrawals from WRPA 4, were consumed. The remaining 765 c.f.s. was released and returned to streamflow, thus resulting in a net increase to streamflow of about 35 c.f.s.

The major consumption of water in the area was for irrigation of crops. About 340 c.f.s., or 58 percent of all the water consumed, was for this purpose, with an average return flow to streamflow of about 120 c.f.s. Commercial fishing industries in the area consumed about 104 c.f.s., with most of the water coming from ground water sources and very little being returned to nearby streams.

The use of water for navigation on the lower Yazoo River occurs only on an intermittent basis because of insufficient depths during low flow periods. Currently, a 9-foot navigation depth from Greenwood, Miss., to the mouth is available about 46 percent of the time, with a controlling depth of 4 to 9 feet existing for the remainder of the time. There are no existing locks and dams on the Yazoo River to provide the required navigation pools; however, releases from the four flood-control reservoirs are regulated to aid navigation during critical low flow periods. Another nonconsumptive use is recreation, which is popular in the area; hence, most lakes and streams are being used for fishing, boating, and related water sports.

Additional information on the withdrawals of ground and surface water in WRPA 4 during 1970 is given in table 15 of the Regional Summary. This table also presents pertinent data on the consumption of water for various purposes in this WRPA and each of the other areas in the Lower Mississippi Region.

Stream Management

All of the various users of an area's water resources benefit from an efficient method of stream management in the area. In WRPA 4, stream management practices include changes in stream systems by the use of dams for decreasing floodflows and supplementing low flows, the construction of levees and channel improvements, and diversion of water for various uses. The effect of some of these practices may or may not be reflected by marked changes in streamflow, and many subsequent years of streamflow records may be required to define their effects on the stream system.

Impoundments. Table 94 presents pertinent data on reservoirs in WRPA 4 which have a capacity of 5,000 acre-feet or more. These four reservoirs control a drainage area of more than 4,400 square miles, or about two-thirds of the hill area, and are capable of impounding more

Table 94 - Reservoirs Having a Total Capacity of 5,000 Acre-Feet or More, WRPA 4

Name	Stream	Total Storage (acre-feet)	Active Storage (acre-feet)	Surface Area (acre-feet)	Use 1/
Arkabutla	Coldwater River	525,300	493,800	33,400	F,R
Sardis	Little Tallahatchie River	1,569,900	1,461,900	58,500	F,R
Enid	Yocona River	660,000	602,400	28,000	F,R
Grenada	Yalobusha River	1,337,400	1,251,700	64,600	F,R

1/ F - flood control, R - recreation.

than 3.8 million acre-feet of water at the flood-control pool [120]. They were constructed primarily for the purpose of flood control, with incidental benefits from recreation, water supply, conservation, and navigational uses.

The operation of the reservoirs for flood-control purposes usually follows a pattern of discharging excess water in the early months of the fall, then maintaining active capacity during the winter and spring months to allow for the storage of runoff from heavy winter and spring rains. A large amount of recreational activity occurs at the four reservoirs mentioned above; hence, reservoir regulation is performed in a manner to retain lake levels favorable to recreation during the summer months for as long as possible.

Operation to regulate low flows involves storage of inflow during the flood season from December through May and release of these flows at a uniform rate from June through November to provide water for navigation during critical periods and for irrigation and other purposes.

Many small floodwater retarding and desilting structures have been constructed in the Yazoo Basin by the U. S. Soil Conservation Service. Most of the dams were built in the headwater areas of small intermittent streams in the hill areas. Streams on which structures have been constructed are Batupan, Pelucia, Greasy, Oaklimeter, Persimmon, Potaccowa, and Turkey Creeks [104].

Channel modification. Throughout WRPA 4, channel modification has taken place on many parts of the Yazoo-Tallahatchie-Coldwater drainage system. An extensive project to control floods originating within the headwater area was approved in 1936 and provided for four flood-control dams, two auxiliary channels, levees, and channel improvement works. The Sardis, Enid, Grenada, and Arkabutla Dams, and the Whittington Auxiliary Channel, which joins the Yazoo River between Satartia and Silver City, Miss., are complete. Local flood-protection works have been completed at Greenwood, Belzoni, and Yazoo City, Miss. [131]. The overall plan includes more than 870 miles of channel straightening and clearing and snagging (64 percent complete), and 580 miles of levees (45 percent complete)[123].

A project approved in 1941 to provide protection from Mississippi River backwater flooding within the lower part of the Yazoo Basin includes about 98 miles of levees, an auxiliary channel 25 miles in length, and several drainage structures, including a large structure on Steele Bayou [134]. The project is about 31 percent complete. Other flood-control works in WRPA 4 consist of channel improvements on 740 miles of streams within the Steele Bayou, Deer Creek, and Sunflower River Basins, which are 43 percent complete [123]. Numerous small watershed projects and bank stabilization works have also been constructed on streams in the hill area of the Yazoo Basin.

Pumping stations, ring levees, and floodgates have been constructed at Greenwood and Yazoo City, Miss. Capacities of these stations are 675 and 540 c.f.s., respectively. A smaller pumping plant is located on McKinney Bayou to pump floodflows from the area over the Mississippi River levee.

Streamflow

Various periods of flow at the selected gaging stations were used in this report because of the availability of discharge data at the sites. On some of the stations, the period of record was modified to reflect changes in the streamflow characteristics at the site due to changes in stream management, diversions, channel improvements, or regulation upstream from the site. For each of the selected gaging stations, the selected period of record provides reasonably good data for statistical analysis and study, and the data are considered representative of flows which could occur under present levels of development.

Measurement facilities. Streamflow data at 14 sites in WRPA 4 were selected for presentation in this section. The streamflow at these sites is considered to be representative of the various drainage and hydrologic conditions which exist in the area. Locations of these sites are shown in figure 173, a map of the mean annual runoff for the area, and are identified by U. S. Geological Survey station numbers. Table 95 is a summary of the streamflow data at each of the selected sites and presents such data as the controlling agency, the drainage areas, period

Table 95 - Streamflow Summary for Selected Sites, WRPA 4

Stream	Station	Agency	Station No.	Gage Datum (feet m.s.l.)	Drainage Area (square miles)	Period of Record 1/	Annual Mean Flows (c.f.s.)			Momentary Flows (c.f.s.)		Stage Data (feet m.s.l.)	
							Mean	Maximum	Minimum	Maximum	Minimum	Highest	Lowest
Cane Creek	New Albany, Miss.	USGS	7-2660	356.74	22	1950-69	38	68	18	8,680	0	375.8	--
Little Tallahatchie River	Etta, Miss.	USGS	7-2680	273.48	526	1939-69	797	1,423	292	79,000	4	302.8	274.7
Clear Creek	Oxford, Miss.	USGS	7-2710	273.47	10	1951-69	14	23	9	6,500	3	287.8	--
Little Tallahatchie River	Sardis Dam near Sardis, Miss.	USCE	7-2725	0.00	1,545	1941-70	2,207	3,312	1,208	5,780	15 2/	211.6	Dry
Yocona River	Oxford, Miss.	USGS	7-2740	272.20	262	1952-69	329	587	140	44,100	4	295.9	269.7
Yocona River	Enid Dam near Enid, Miss.	USCE	7-2750	0.00	560	1952-70	844	2,164	408	6,060	5 2/	198.5	Dry
Coldwater River	Arkabutla Dam near Arkabutla, Miss.	USCE	7-2785	0.00	1,000	1944-70	1,355	2,492	630	10,200	5 2/	199.0	170.3
Tallahatchie River	Lambert, Miss.	USCE	7-2800	123.83	1,980	1943-70	2,757	5,256	1,201	16,100	68	157.3	130.3
Tallahatchie River	Swan Lake, Miss.	USCE	7-2810	113.38	5,130	1952-70	6,822	10,380	3,870	28,300	336	143.8	115.7
Yalobusha River	Calhoun City, Miss.	USGS	7-2820	236.06	305	1951-69	332	651	91	23,000	0	251.3	Dry
Skuna River	Bruce, Miss.	USGS	7-2830	238.75	254	1948-69	352	579	113	61,400	1	262.9	235.2
Yalobusha River	Grenada Dam near Grenada, Miss.	USCE	7-2850	0.00	1,320	1954-70	1,672	3,308	506	4,880	5 2/	180.9	Dry
Yazoo River	Greenwood, Miss.	USCE	7-2870	92.07	7,450	1954-70	9,705	15,060	5,062	28,200	708	126.3	98.7
Big Sunflower River	Sunflower, Miss.	USCE	7-2885	92.95	767	1936-67	956	2,118	326	11,700	81	121.3	93.8

1/ This period of record applies to annual flows and not necessarily to momentary flows or stage data; however, the momentary flows and stage data occurred under conditions similar to that which existed during the period of record indicated.
2/ Minimum when gates are closed due to leakage.

of record used in this report, gage datum, stage data, and other pertinent hydrologic data for each site [99].

Average discharge for WRPA 4. Figure 174 is a graphical representation of the average monthly discharge generated within WRPA 4. This figure also presents the maximum, minimum, and 20 and 80 percent duration flows by months for the area. Also given are the mean, maximum, minimum, and 20 and 80 percent duration annual flows for the area. All of these flows originate from within the WRPA with no flows entering the area from the outside. A map of isopleths showing the mean annual runoff for WRPA 4 is shown in figure 173.

Average discharge for selected stations. Detailed data at each of the selected gaging stations shown in table 95 are presented in this section of the report. Tables 96-109 present observed mean discharges by months for each of the selected sites in WRPA 4. These tables also show the average monthly and average annual flows for the period of record at each station. These flows reflect regulation and water use under 1973 levels of development in the area [162].

Figures 175-183 present peak flow frequency curves for selected sites in WRPA 4. These curves are a reflection of the annual peak discharges for the station and were computed using the log Pearson Type III procedure [6]. Due to regulation of peak flows, no frequency curves were computed for stations immediately below the reservoirs.

Low flow frequency curves for selected sites are shown in figures 184-191. These curves represent the lowest average flows for periods of 7, 30, 60, and 90 consecutive days. Due to regulation of low flows, no curves were computed at stations directly affected by regulation of upstream reservoirs.

Duration curves for daily flows at selected sites in WRPA 4 are presented in figures 192-205. These curves show the percent of time that specified discharges were equaled or exceeded at the sites during given periods. The curves indicate flow characteristics of the streams throughout their entire range of discharges without regard to the sequence of occurrences. The maximum daily flows at the stations are listed on the curves because of the lack of space required to extend the curves to the zero percent exceedence point.

Tables 110-123 present data on the dependable yield characteristics at each of the selected discharge sites. These tables show the lowest mean flows for from 1 to 10 consecutive years of the period of record. The relationship of these lowest mean flows to the period of record mean is also shown. The minimum yearly flow for the stations in WRPA 4 ranges between 27 and 59 percent and averages 43 percent of the mean annual flow. For the 10 consecutive years of lowest mean flow, the

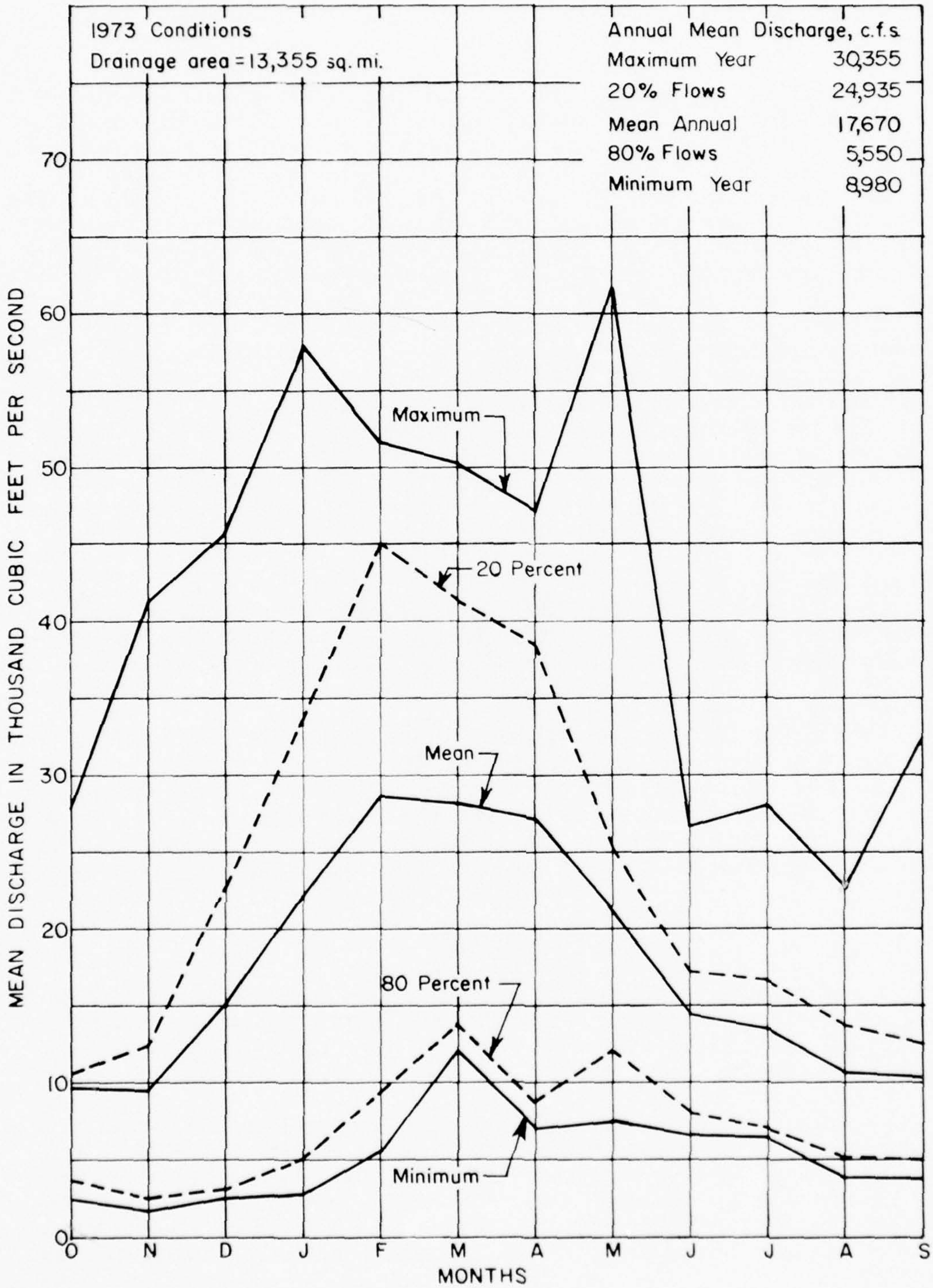

Figure 174 Monthly discharge from WRPA 4

dependable yield averages about 89 percent of the mean annual flows for the WRPA.

Variation in precipitation and discharge. Variations in rainfall cause both long-term and seasonal variations in discharge on all of the streams in WRPA 4. Figure 206 shows long-term variations in precipitation and discharge for the Yazoo River at Greenwood, Miss. Mean and 5-year averages for both the precipitation and discharge are shown. The 5-year moving averages illustrate the general relationship between precipitation and discharge. These data do not indicate a long-term trend or long-term rhythmic cycle of precipitation or discharge at either site.

Seasonal variations in runoff and streamflow are depicted in the observed discharges given in tables 96-109. The major peak flows usually occur during the months of January to May. This is usually caused by the heavy winter and spring rainfall in the area. Low runoff is produced during the months of July to November and is generally attributed to the small amount of rainfall in the area at this time of year. These discharge tables can be used to define streams that receive large amounts of flow from surface or underground reservoirs, as they exhibit the smallest variations in monthly flows.

Flow Velocities

No low flow velocities for streams in WRPA 4 were available for publication in this report because no time of travel studies have been made in the area.

River Profile

A profile of the Yazoo-Tallahatchie-Coldwater River from the mouth of the Yazoo River to Arkabutla Dam on the Coldwater River is shown in figure 207 [135]. This profile was constructed from topographic maps and data from available reports. The 50 percent duration flow line was plotted from data at various gaging stations along the river. Profiles for other streams in the area are not presented in this report.

Quality

Surface water in WRPA 4 is generally good for most uses. The economy of this area is almost entirely agricultural. Much of the area is irrigated and, during the summer, part of the streamflow consists of irrigation return flow.

Because strata underlying the area are composed of many different materials, the dissolved-solids content of the low-flow surface waters ranges from 14 mg/1 in Hurricane Creek near Oxford, Miss., to 142 mg/1 in Hayes Creek near Vaiden, Miss. (table 124). A sample of water from a stream draining the Quaternary alluvium contained 0.3 mg/1 of fluoride, and one from a stream draining the Tallahatta Formation and Winona and

Sparta Sands contained 0.4 mg/1. Other water sampled in this part of the region had a fluoride content of not more than 0.2 mg/1. Except for four samples from Hayes Creek near Vaiden, Miss., and Yalobusha River at Calhoun City, Miss., no sample had a chloride content greater than 20 mg/1. Samples from most streams had less than 10 mg/1 of chloride. Iron concentration ranged from 0 to 0.62 mg/1, with most waters containing less than 0.3 mg/1. The pH of samples ranged from 6.4 to 7.5, but most fell between 6.5 and 7.2. Color in the surface water ranged from 5 to 50. The higher values probably were due to organic materials leached from vegetation [104].

Water draining from the Quaternary area is the calcium bicarbonate type (table 124) which is characteristic of most water obtained from these deposits in the Lower Mississippi Region. This is as expected, because most of the alluvial material in the Lower Mississippi Region contains calcium carbonate.

The Cockfield Formation and Sparta Sand of Tertiary age crop out just east of the Mississippi alluvial plain. Water from these formations has a lower dissolved-solids content and a slightly higher sodium content than does water from the Quaternary alluvium. The calcium, magnesium, and bicarbonate content of the water from these two Tertiary units probably is affected by the loess mantle overlying a large part of the area.

Water from the Winona Sand has a dissolved-solids content of about 130 mg/1, whereas the water from the Cockfield Formation and Sparta Sand has a dissolved-solids content of about 60 mg/1 and water from the Quaternary deposits has a dissolved-solids content of about 100 mg/1. The higher dissolved-solids content of water from the Winona Sand is principally due to higher concentrations of sodium, sulfate, and chloride.

Analyses of water from streams whose drainage basins are entirely in the Tallahatta Formation indicate that the dissolved-solids content of water discharged by this formation is low; the dissolved-solids content ranges from 14 to 25 mg/1. Water from streams whose drainage basins are in both the Tallahatta Formation and Wilcox Group generally has a dissolved-solids content intermediate between that of water from the Tallahatta Formation and that of water from the Wilcox deposits. The dissolved-solids content of water from streams draining Wilcox deposits ranges from 32 to 56 mg/1.

Water from streams draining the Porters Creek Clay and the Wilcox is similar in chemical composition to water from streams draining only Wilcox deposits; however, samples collected from the Yalobusha River at Calhoun City, Miss., and Skuna River at Bruce, Miss., which drain Wilcox deposits, contained greater concentrations of sodium, sulfate, and chloride.

Chiwapa Creek drains the Clayton Formation, Prairie Bluff chalk, and Ripley Formation. Water sampled from this stream has a dissolved-solids content of about 125 mg/l, which is largely calcium bicarbonate.

Water from streams that derive their base flow from the Tuscaloosa Group and from the McShan and Eutaw Formations generally is the least mineralized of all the low-flow water sampled in the area. No individual chemical constituent attains a concentration of more than a few milligrams per liter, and the dissolved-solids content is generally less than 30 mg/l.

Table 96 - Observed Mean Discharge in c.f.s., Sta 72660.00, Cane Creek near New Albany, Miss., 1950-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1950	--	--	--	--	--	--	28	22	29	7	33	25	--
1951	10	31	61	135	149	141	81	18	12	29	6	5	68
1952	4	41	164	108	72	79	45	28	10	5	5	1	46
1953	1	4	10	26	110	106	90	90	7	56	2	1	41
1954	1	2	8	75	31	18	48	43	12	3	1	1	20
1955	1	1	4	6	31	178	86	16	36	28	4	1	32
1956	2	4	6	11	153	34	67	21	15	10	5	1	27
1957	1	1	18	101	94	31	98	13	77	52	15	58	46
1958	33	154	68	41	28	44	120	77	18	12	4	56	54
1959	7	19	14	37	50	28	35	18	22	14	5	5	21
1960	12	12	54	62	48	90	27	26	6	8	13	6	30
1961	38	21	38	27	86	166	56	22	15	6	3	2	39
1962	5	41	126	156	127	53	85	21	18	5	3	6	53
1963	5	5	7	7	13	50	21	39	16	38	22	5	18
1964	2	3	18	33	40	177	156	21	6	19	8	6	40
1965	4	13	91	62	102	172	43	16	7	7	6	2	43
1966	2	3	6	9	108	14	23	60	12	8	11	11	22
1967	9	20	42	20	24	50	19	110	15	17	16	3	28
1968	5	7	88	111	31	100	85	72	10	10	3	15	44
1969	17	77	58	27	113	44	168	21	8	6	6	12	46
Mean	8	24	46	55	74	82	69	37	17	17	8	11	38

Table 97 - Observed Mean Discharge in c.f.s., Sta 72680.00, Tallahatchie River at Etta, Miss., 1939-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1939	10	78	57	1,062	3,750	1,379	1,482	1,387	3,174	473	101	34	1,082
1940	22	31	130	178	950	1,547	1,898	249	371	948	160	25	542
1941	19	513	1,470	716	353	600	511	209	208	508	228	59	449
1942	150	1,019	429	446	1,305	1,441	986	206	81	42	87	14	517
1943	16	23	865	232	313	1,684	295	107	35	38	41	154	316
1944	9	251	100	374	2,256	2,871	1,466	747	50	220	147	107	716
1945	16	46	1,091	2,473	1,616	2,346	736	368	495	105	152	108	795
1946	75	1,085	1,257	3,948	3,472	1,734	536	1,460	417	913	497	89	1,290
1947	79	1,350	608	3,354	486	1,353	2,075	506	273	406	137	129	896
1948	37	678	566	582	5,856	2,615	1,550	326	79	148	33	63	1,044
1949	28	3,414	710	3,744	1,535	2,398	740	537	648	118	140	43	1,171
1950	256	198	511	3,174	2,401	2,802	405	866	555	312	433	929	1,070
1951	142	881	1,068	2,538	3,350	3,214	1,302	249	167	555	77	37	1,131
1952	43	295	3,539	1,975	1,331	1,533	940	284	80	43	55	16	844
1953	17	47	106	329	2,859	2,289	1,456	1,704	57	464	33	20	781
1954	17	24	109	1,250	675	230	478	573	81	44	13	13	292
1955	17	19	174	119	584	3,546	2,084	590	484	657	55	17	695
1956	20	40	77	86	3,036	487	1,884	792	151	88	27	14	558
1957	18	18	201	1,707	2,757	609	1,807	166	751	615	52	413	759
1958	532	3,877	930	748	455	1,048	2,436	1,330	424	313	75	1,930	1,174
1959	103	352	167	987	1,327	489	648	234	1,294	177	67	95	494
1960	130	149	1,829	1,526	900	2,305	390	299	74	52	91	111	654
1961	496	205	667	586	2,373	3,933	1,109	244	142	71	68	46	828
1962	60	1,351	3,896	4,109	2,778	1,070	2,848	318	459	102	45	41	1,423
1963	36	48	67	65	178	1,187	842	428	200	1,310	216	191	397
1964	24	41	525	967	995	3,633	3,442	323	85	667	213	58	914
1965	53	324	1,587	1,024	2,711	3,304	604	132	99	47	31	30	828
1966	24	35	70	116	2,842	231	450	1,542	206	72	64	60	475
1967	50	68	494	244	475	781	276	2,144	289	866	1,446	36	597
1968	46	107	1,984	3,256	540	2,060	1,672	2,090	112	68	52	350	1,028
1969	220	1,427	1,289	505	2,460	928	3,818	242	145	49	90	79	937
Mean	89	580	857	1,368	1,836	1,795	1,327	666	376	338	158	171	797

Table 98 - Observed Mean Discharge in c.f.s., Sta 72710.00, Clear Creek near Oxford, Miss., 1951-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1950	--	--	--	--	--	--	15	13	17	12	22	10	--
1951	6	15	15	36	29	29	21	9	11	11	8	7	23
1952	8	11	45	24	17	25	15	8	7	6	7	7	15
1953	6	8	9	11	40	33	29	36	7	6	6	6	16
1954	6	8	14	36	13	9	9	25	11	7	6	6	12
1955	7	6	9	7	12	56	48	14	7	17	8	11	16
1956	6	6	9	7	64	8	35	11	6	6	6	5	14
1957	5	5	9	34	30	9	38	9	43	13	5	7	17
1958	7	40	11	8	8	11	39	18	11	16	6	33	17
1959	6	13	7	13	24	10	9	14	8	14	6	9	11
1960	8	10	25	12	12	28	8	10	7	6	12	7	11
1961	10	7	11	8	32	39	14	13	7	12	7	7	13
1962	6	23	44	37	32	13	27	8	15	17	7	9	19
1963	8	7	7	8	8	15	32	9	7	44	7	7	13
1964	7	7	9	10	9	23	34	8	8	12	8	9	12
1965	7	9	22	15	45	31	10	11	7	6	7	7	14
1966	7	8	9	8	39	10	16	15	7	9	7	13	12
1967	7	7	16	8	8	10	11	13	8	9	10	6	9
1968	6	9	11	39	13	36	19	46	8	7	7	19	18
1969	9	38	15	9	23	11	25	9	8	8	11	11	14
Mean	6	12	15	17	24	21	22	14	10	11	8	9	14

Table 99 - Observed Mean Discharge in c.f.s., Sta 72725.00, Tallahatchie River at Sardis Dam near Sardis, Miss., 1941-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1941	0	281	986	2,568	1,916	1,144	2,291	1,855	301	1,193	1,544	868	1,243
1942	432	1,435	1,794	1,189	2,453	2,306	633	2,369	4,144	2,142	0	0	1,568
1943	0	0	102	1,688	2,220	1,042	2,108	2,488	1,483	2,558	675	378	1,223
1944	0	0	634	1,647	1,491	972	0	1,533	4,390	4,600	4,247	3,326	1,905
1945	2,425	317	460	2,373	2,585	2,466	2,893	3,758	4,529	4,900	4,135	577	2,624
1946	78	3,116	4,213	766	1,132	3,140	5,143	4,044	4,428	3,449	5,259	4,902	3,312
1947	4,868	1,502	3,600	2,289	2,569	3,341	1,191	2,339	2,900	3,674	3,932	761	2,778
1948	0	851	4,188	3,214	885	1,162	3,341	3,467	4,886	4,452	4,712	4,309	2,963
1949	910	324	2,604	1,056	3,294	2,972	3,171	3,126	4,065	4,875	4,928	5,083	3,030
1950	4,298	1,331	920	2,255	2,869	2,015	3,285	3,385	4,446	4,627	4,888	4,919	3,271
1951	2,513	878	3,646	2,486	2,826	2,657	2,470	3,211	4,753	4,416	4,591	3,697	3,184
1952	0	0	1,042	2,756	3,075	3,159	3,028	3,541	3,884	3,957	3,972	589	2,419
1953	0	1,337	913	752	1,660	2,574	2,478	209	2,865	4,599	4,826	5,021	2,267
1954	3,443	1,121	1,180	1,301	2,012	2,002	1,906	1,658	982	1,160	917	839	1,543
1955	770	214	288	1,080	716	644	341	2,815	2,941	3,284	4,221	4,449	1,821
1956	1,374	394	1,274	506	1,396	2,420	2,383	2,506	2,428	2,486	1,759	1,166	1,677
1957	730	687	973	1,435	1,418	2,554	2,609	2,641	2,564	2,257	3,035	3,468	2,033
1958	3,279	859	2,533	3,592	4,456	3,214	1,863	743	2,740	2,626	4,080	1,871	2,649
1959	2,685	3,332	2,307	1,827	2,343	1,955	1,642	1,742	2,556	2,450	73	15	1,907
1960	15	15	15	2,355	3,870	3,471	4,203	3,638	3,147	1,769	76	482	1,927
1961	1,033	204	2,322	2,203	838	1,689	1,300	3,179	2,943	3,139	2,811	2,403	2,005
1962	1,696	391	1,572	2,613	3,795	3,468	3,472	4,151	3,661	3,764	3,555	3,092	2,935
1963	3,066	708	24	1,668	679	773	620	452	1,514	1,464	1,654	1,878	1,208
1964	1,605	730	1,007	1,756	1,831	1,217	1,520	1,696	3,567	3,570	3,621	2,181	2,025
1965	2,282	2,215	2,538	3,175	2,179	2,337	3,541	3,611	2,715	2,536	1,626	1,434	2,515
1966	2,581	467	865	737	503	2,331	758	1,117	2,603	1,748	1,100	637	1,296
1967	1,938	918	967	1,841	589	501	425	353	1,386	1,823	3,449	2,396	1,390
1968	3,061	1,647	1,712	1,492	2,682	975	1,992	962	3,905	3,528	2,381	1,764	2,179
1969	3,215	1,780	1,712	3,381	1,859	2,894	816	3,380	3,652	3,628	3,045	3,025	2,698
1970	3,136	1,474	1,420	1,886	2,456	613	1,078	3,168	4,347	4,104	3,568	4,108	2,613
Mean	1,714	951	1,594	1,930	2,087	2,073	2,083	2,438	3,157	3,159	2,959	2,321	2,207

Table 100 - Observed Mean Discharge in c.f.s., Sta 72740.00, Yocona River near Oxford, Miss., 1952-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1952	35	101	1,534	754	564	652	444	91	35	17	18	15	355
1953	13	32	52	129	1,134	1,000	565	699	24	25	17	12	308
1954	13	20	58	401	293	95	261	446	58	21	8	9	140
1955	13	14	146	96	408	1,660	1,188	472	165	216	27	24	369
1956	14	20	38	44	1,331	284	958	486	71	23	11	7	274
1957	12	13	103	694	1,294	420	768	72	505	407	17	235	378
1958	316	2,145	406	337	227	510	1,011	450	97	213	34	1,239	582
1959	66	166	91	466	612	267	405	106	633	47	23	30	242
1960	47	56	969	687	411	1,031	176	126	32	17	42	38	302
1961	64	61	221	332	1,166	1,299	563	178	52	34	23	26	334
1962	19	463	1,490	1,495	882	513	1,414	112	485	94	35	42	587
1963	30	39	52	48	138	606	588	165	42	526	80	30	195
1964	15	21	185	354	398	1,442	1,420	143	27	164	47	27	353
1965	25	145	343	289	958	1,083	229	53	49	18	25	26	270
1966	16	29	40	80	1,233	99	164	715	36	29	70	41	212
1967	39	31	353	116	203	332	326	439	117	234	417	19	218
1968	18	68	809	1,294	234	735	721	865	47	40	22	295	429
1969	65	533	663	223	1,028	438	1,243	90	63	25	63	64	374
Mean	45	219	419	435	695	692	691	317	141	119	54	121	329

Table 101 - Observed Mean Discharge in c.f.s., Sta 72750.00, Yocona River at Enid Dam, near Enid, Miss., 1952-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1952	102	266	2,642	2,178	1,532	1,603	1,282	376	132	89	89	72	865
1953	71	123	156	0	305	1,210	1,195	2	537	1,184	1,250	1,104	596
1954	878	145	397	391	1,042	755	244	457	260	252	265	233	441
1955	123	104	152	441	377	378	341	761	1,319	1,443	2,070	1,693	769
1956	1,376	147	183	105	685	1,232	1,219	980	604	579	566	403	674
1957	797	92	172	409	822	1,295	1,170	1,316	1,291	1,120	1,230	1,530	937
1958	1,424	391	1,283	1,706	1,871	1,530	946	232	920	803	1,339	726	1,095
1959	1,790	1,496	1,913	1,018	256	552	316	303	487	658	1,778	207	906
1960	285	126	367	1,692	1,207	745	1,107	663	632	337	278	632	670
1961	701	446	234	1,175	238	526	590	1,444	1,372	1,145	1,253	1,154	857
1962	625	1,232	933	975	1,189	1,308	1,681	1,876	1,710	1,783	1,657	1,434	2,164
1963	1,794	369	108	120	134	376	363	217	628	589	453	1,273	535
1964	1,038	320	536	458	553	770	813	522	1,068	1,280	1,252	510	759
1965	680	1,551	866	956	482	534	610	708	686	601	637	644	746
1966	1,083	152	112	302	175	660	378	555	1,211	326	1,328	370	558
1967	182	154	508	594	162	133	79	96	220	843	900	989	408
1968	1,261	720	758	489	1,334	359	800	888	1,171	1,416	1,353	1,603	1,010
1969	1,074	364	849	1,109	1,069	826	219	858	1,378	1,363	1,104	1,127	945
1970	1,232	675	786	487	685	430	675	2,340	1,181	1,641	1,204	1,808	1,095
Mean	869	467	682	769	743	801	738	768	885	918	1,053	921	844

Table 102 - Observed Mean Discharge in c.f.s., Sta 72785.00, Coldwater River at Arkabutla Dam, near Arkabutla, Miss., 1944-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1944	150	216	282	352	2,677	2,664	2,666	3,206	2,026	208	244	551	1,261
1945	279	413	1,033	3,293	2,513	3,850	4,049	3,339	951	357	423	362	1,735
1946	526	1,535	3,483	4,281	4,847	4,396	3,098	1,438	2,744	2,075	1,214	429	2,492
1947	264	281	1,330	1,850	2,634	1,268	949	800	1,713	2,320	1,099	365	1,233
1948	276	416	586	1,041	2,910	4,523	3,658	2,274	1,093	740	619	306	1,531
1949	84	1,464	3,027	3,014	3,161	2,595	3,345	2,091	1,586	1,637	675	522	1,926
1950	508	421	1,088	3,528	4,532	4,331	3,039	1,967	1,049	744	752	1,313	1,923
1951	810	576	2,623	2,763	3,340	2,496	2,204	1,482	613	1,776	190	0	1,566
1952	0	563	2,006	2,127	3,598	3,482	2,772	1,490	602	226	225	190	1,433
1953	221	404	395	361	1,824	2,626	2,609	4,211	4,831	2,496	1,062	481	1,790
1954	273	172	615	841	2,239	1,443	486	812	507	405	193	44	660
1955	379	128	139	340	825	2,049	3,640	2,637	1,141	1,592	1,063	470	1,202
1956	398	291	661	178	3,683	3,176	2,035	1,398	529	521	320	179	1,104
1957	232	147	287	952	3,184	3,018	1,746	1,130	1,258	1,063	508	903	1,188
1958	710	1,599	3,059	3,097	672	1,072	1,286	2,426	1,790	827	1,058	968	1,556
1959	3,522	616	310	1,611	2,313	1,927	774	294	205	328	634	1,147	1,135
1960	128	5	1,574	2,942	1,362	2,178	1,311	738	524	360	309	830	1,024
1961	1,161	332	593	805	481	3,490	3,382	1,964	867	678	401	280	1,202
1962	311	856	1,367	3,223	3,085	2,876	1,141	628	614	561	592	641	1,324
1963	794	295	154	113	643	1,419	941	530	840	618	337	880	630
1964	896	168	629	964	702	1,627	1,743	3,084	1,022	597	549	496	1,039
1965	759	1,002	2,760	3,402	2,260	2,575	3,736	1,079	304	303	161	255	1,549
1966	817	231	139	258	1,090	2,244	647	801	1,613	311	198	158	706
1967	840	255	593	340	135	1,280	1,208	2,319	1,267	1,832	1,031	981	1,015
1968	615	234	1,412	2,175	2,169	2,032	2,418	1,570	1,137	539	222	300	1,232
1969	1,424	893	2,633	2,546	3,083	1,818	2,403	2,955	832	616	461	796	1,705
1970	1,031	249	1,449	1,319	2,056	2,551	1,696	1,764	1,067	1,541	1,287	938	1,412
Mean	645	510	1,268	1,767	2,297	2,556	2,184	1,793	1,212	936	586	548	1,355

Table 103 - Observed Mean Discharge in c.f.s., Sta 72800.00, Tallahatchie River near Lambert, Miss., 1943-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1943	139	790	1,986	2,434	2,179	7,721	3,627	1,058	499	265	219	404	1,778
1944	190	305	350	682	4,055	5,825	7,613	5,374	2,617	273	328	879	2,360
1945	545	564	2,746	8,645	5,668	8,941	7,244	5,232	1,736	525	690	550	3,585
1946	1,005	3,129	5,244	12,370	11,570	8,215	5,924	4,711	4,594	4,138	1,889	680	5,256
1947	438	1,145	1,837	6,268	4,164	2,940	2,498	2,286	2,651	2,989	1,315	551	2,417
1948	307	796	1,027	1,874	8,413	10,460	7,636	4,225	1,690	988	1,544	471	3,265
1949	196	4,115	5,133	7,716	6,622	5,201	6,553	2,925	4,283	2,421	1,103	743	3,895
1950	1,490	787	3,678	9,919	11,490	10,090	5,134	3,974	2,591	1,112	744	1,794	4,361
1951	1,071	1,092	4,258	8,109	7,210	4,172	4,261	2,361	1,119	2,383	369	205	3,032
1952	140	906	5,966	4,080	7,532	6,932	4,648	2,459	1,094	459	411	315	2,961
1953	316	498	719	650	5,108	5,713	4,961	12,970	6,636	2,809	1,405	582	3,522
1954	381	283	988	3,071	3,348	1,962	1,004	1,855	692	513	304	129	1,201
1955	407	216	297	472	2,042	5,430	9,830	3,952	2,006	2,058	1,351	770	2,397
1956	540	666	1,103	638	10,350	4,526	3,328	2,866	1,269	762	454	300	2,198
1957	255	231	448	2,166	7,992	4,306	4,606	2,167	2,599	2,209	679	1,382	2,377
1958	1,622	6,150	6,460	4,813	1,546	3,338	4,176	7,323	3,165	2,506	1,531	3,709	3,876
1959	3,874	1,694	725	4,008	5,499	3,115	1,992	903	1,266	1,195	1,046	1,796	2,239
1960	572	184	4,167	4,956	2,897	5,199	2,060	2,189	1,209	720	608	1,140	2,166
1961	1,861	879	1,527	1,796	4,174	7,588	7,042	3,174	1,550	918	651	477	2,636
1962	413	1,833	5,138	7,771	5,510	4,979	2,399	1,046	1,450	1,103	841	885	2,780
1963	801	562	307	316	1,174	3,803	1,803	2,001	1,377	1,584	746	1,042	1,293
1964	1,078	264	1,027	2,023	1,468	3,530	6,883	4,680	1,469	957	1,236	1,050	2,138
1965	1,217	1,461	7,062	5,726	6,680	5,603	5,726	1,965	720	562	454	667	3,153
1966	1,124	245	284	400	5,175	2,958	1,115	3,284	1,928	550	473	367	1,468
1967	1,376	617	1,213	763	465	2,583	2,359	4,838	1,998	2,119	1,771	1,175	1,786
1968	698	426	2,331	5,537	3,646	5,172	4,670	4,885	1,831	1,119	397	714	2,621
1969	2,084	2,458	5,972	3,622	7,235	3,042	7,452	3,952	1,760	1,000	1,174	1,050	3,400
1970	1,190	927	3,479	4,089	4,492	6,910	4,768	3,265	2,448	1,883	1,798	1,196	3,036
Mean	904	1,186	2,695	4,104	5,275	5,366	4,690	3,640	2,080	1,432	912	894	2,757

Table 104 - Observed Mean Discharge in c.f.s., Sta 72810.00, Tallahatchie River at Swan Lake, Miss., 1952-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1952	692	1,494	10,540	13,790	15,860	14,540	12,320	8,079	5,962	5,045	4,676	1,626	7,868
1953	627	1,974	2,275	1,774	10,120	13,520	12,140	19,200	12,000	9,275	7,170	6,583	8,036
1954	5,055	1,874	3,058	6,298	7,860	5,560	3,922	6,499	2,525	2,180	1,708	1,389	3,979
1955	1,507	801	1,001	2,355	4,362	9,555	15,730	8,743	6,690	7,178	8,204	7,571	6,139
1956	3,971	1,557	3,241	1,525	16,720	10,710	8,987	7,082	4,690	3,976	2,906	2,104	5,575
1957	1,953	1,314	1,971	5,214	13,950	9,640	11,070	7,369	7,374	7,760	5,288	6,985	6,597
1958	7,425	13,050	12,730	11,440	9,469	10,320	9,617	15,700	8,466	8,686	7,460	10,080	10,380
1959	9,191	7,615	5,710	7,409	11,720	7,170	5,094	3,766	4,949	5,062	3,382	2,338	6,076
1960	1,451	676	6,328	10,630	9,730	12,420	8,445	7,481	5,310	3,249	1,672	2,294	5,803
1961	4,340	1,760	4,541	6,524	8,046	14,523	13,444	9,224	6,808	6,885	5,474	4,558	7,177
1962	3,220	5,157	12,912	16,397	14,361	13,835	11,031	8,303	7,841	7,580	6,654	6,599	9,490
1963	6,217	2,240	811	2,303	2,334	7,227	3,578	4,486	4,022	4,982	3,596	4,653	3,870
1964	4,190	1,589	3,097	5,585	5,339	10,189	12,716	10,858	6,647	6,669	7,742	5,099	6,643
1965	4,514	6,649	13,833	12,103	13,791	12,035	13,085	7,545	4,821	4,122	3,116	3,075	8,223
1966	4,994	1,496	1,642	1,679	9,186	6,983	3,254	7,178	6,447	3,278	3,200	2,013	4,250
1967	3,333	2,161	4,498	4,297	2,019	4,881	4,610	8,462	4,429	5,793	7,319	4,825	4,749
1968	5,870	3,501	6,257	12,360	9,314	10,770	10,740	10,700	7,608	6,711	4,912	5,041	7,819
1969	6,901	4,972	13,094	9,351	14,900	8,269	12,538	9,243	7,069	6,264	6,016	5,691	8,692
1970	5,755	4,935	8,043	9,016	8,861	12,511	10,694	9,916	8,677	7,691	7,414	7,141	8,387
Mean	4,274	3,411	6,083	7,371	9,891	10,245	9,632	8,938	6,439	5,915	5,153	4,719	6,822

Table 105 - Observed Mean Discharge in c.f.s., Sta 72820.00, Yalobusha River at Calhoun City, Miss., 1951-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1951	15	115	453	1,497	2,130	1,805	610	36	30	12	1	2	558
1952	2	9	438	266	332	648	313	64	6	2	4	0	173
1953	0	7	12	90	1,118	673	434	647	6	34	5	0	252
1954	0	1	16	341	192	83	92	354	10	1	1	0	91
1955	3	7	73	101	586	1,122	1,165	128	52	197	4	3	286
1956	1	4	13	11	1,199	728	961	478	9	3	7	2	284
1957	2	4	226	1,010	1,226	407	569	14	201	159	4	32	321
1958	140	2,827	564	383	348	641	1,254	921	40	39	45	357	629
1959	24	20	21	337	1,156	413	573	101	476	39	18	14	266
1960	19	28	974	1,095	582	1,345	301	242	6	7	28	2	385
1961	11	31	74	156	1,694	1,251	706	67	13	75	4	6	340
1962	12	684	2,192	2,094	728	519	917	238	406	16	5	3	651
1963	2	9	8	19	66	636	195	266	72	748	19	3	170
1964	1	4	104	449	572	1,655	2,677	87	22	47	23	9	470
1965	34	61	181	135	1,397	1,141	235	10	7	7	14	5	268
1966	3	3	4	44	1,378	268	263	100	9	4	1	7	173
1967	3	12	45	20	268	122	47	223	47	207	113	3	92
1968	8	24	1,220	1,684	110	599	949	963	15	17	42	40	472
1969	9	53	435	235	1,043	737	2,241	58	73	19	12	100	417
Mean	15	205	371	524	848	778	763	263	78	85	18	30	332

Table 106 - Observed Mean Discharge in c.f.s., Sta 72830.00, Skuna River at Bruce, Miss., 1948-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1948	4	130	200	290	2,700	1,648	612	15	29	32	67	17	478
1949	6	1,238	417	2,091	828	1,271	546	279	202	28	11	6	576
1950	129	55	93	1,089	1,306	1,221	120	317	208	331	460	508	486
1951	17	141	449	1,416	1,739	1,583	642	75	96	143	7	8	526
1952	8	57	1,056	721	489	649	372	46	15	5	22	4	286
1953	5	18	30	135	1,234	1,070	507	721	8	127	4	4	321
1954	3	6	36	375	298	58	210	370	11	7	2	2	114
1955	5	7	244	134	526	2,369	993	445	147	177	40	4	424
1956	4	6	35	19	1,069	416	1,319	547	68	10	6	5	292
1957	4	11	321	931	1,084	361	895	36	154	255	10	43	342
1958	174	1,922	590	383	265	670	838	594	54	69	17	895	539
1959	45	130	45	485	894	577	460	164	711	44	9	33	299
1960	65	24	1,041	869	459	998	234	247	12	9	59	13	335
1961	53	93	284	255	1,446	1,249	483	298	91	42	19	26	361
1962	36	799	1,333	1,485	969	500	992	190	558	49	37	12	579
1963	8	14	19	29	87	741	314	213	67	615	54	26	182
1964	6	14	228	528	528	1,878	1,556	100	20	76	25	14	414
1965	11	90	180	187	838	1,009	99	15	11	14	13	14	206
1966	8	13	11	100	1,415	82	108	397	28	6	7	19	182
1967	9	6	101	44	178	73	233	206	72	164	274	8	113
1968	10	53	983	1,525	125	717	853	783	14	10	22	75	431
1969	15	83	412	108	366	410	1,548	63	47	10	9	10	256
Mean	28	223	368	599	856	888	633	278	119	101	53	79	352

Table 107 - Observed Mean Discharge in c.f.s., Sta 72850.00, Yalobusha River at Grenada Dam, near Grenada, Miss., 1954-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1954	21	30	216	255	363	1,539	224	327	2,448	558	59	42	506
1955	40	41	71	1,676	1,298	1,225	933	2,547	2,563	2,439	2,294	2,137	1,440
1956	2,683	635	269	187	1,541	2,624	2,774	2,485	1,462	885	1,219	1,275	1,503
1957	592	818	804	1,833	2,137	2,717	2,550	2,591	1,758	1,605	2,024	2,363	1,813
1958	2,757	586	3,440	4,603	4,380	3,285	1,877	970	2,317	2,885	3,334	2,061	2,705
1959	2,674	3,341	446	1,458	1,138	2,438	1,516	1,124	1,859	2,146	2,564	895	1,804
1960	761	178	768	3,257	3,418	2,651	2,891	1,667	2,139	1,662	944	211	1,707
1961	1,250	940	410	2,022	349	2,145	1,650	3,141	3,141	3,182	2,741	2,994	1,997
1962	1,833	545	2,086	4,422	4,565	4,703	3,765	4,422	4,320	3,327	2,906	2,806	3,308
1963	2,304	609	262	131	413	634	512	228	1,045	1,149	1,470	2,510	939
1964	1,767	587	446	1,606	1,826	2,273	1,809	3,166	3,193	3,206	3,428	1,882	2,099
1965	689	2,043	995	1,020	721	2,261	2,156	811	1,711	1,744	652	1,040	1,320
1966	1,196	34	106	487	358	2,356	571	242	1,818	1,062	994	765	837
1967	1,265	293	333	377	304	370	123	143	574	642	1,079	1,355	574
1968	1,340	738	938	1,601	4,347	3,458	1,790	1,253	3,215	3,057	1,927	1,425	2,082
1969	2,523	1,606	1,015	1,026	1,312	1,602	1,089	3,253	2,878	2,450	2,225	2,242	1,935
1970	2,075	551	296	2,522	2,724	523	812	2,431	2,730	2,784	2,393	2,558	1,866
Mean	1,516	799	759	1,675	1,835	2,165	1,590	1,812	2,304	2,045	1,897	1,680	1,672

Table 108 - Observed Mean Discharge in c.f.s., Sta 72870.00, Yazoo River at Greenwood, Miss., 1954-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1954	5,220	2,195	3,547	7,079	9,210	7,547	4,604	9,665	5,183	3,046	2,013	1,624	5,062
1955	1,690	1,089	1,644	4,889	7,131	12,509	20,917	12,878	9,427	9,815	10,307	9,422	8,476
1956	7,160	2,493	3,694	1,809	19,504	16,645	14,220	9,795	6,485	5,244	4,402	3,632	7,923
1957	2,777	2,488	3,865	8,831	19,796	14,129	15,937	10,420	10,258	10,934	7,381	9,566	9,698
1958	10,800	16,500	18,730	16,840	15,460	14,980	12,720	21,790	12,140	13,260	12,020	15,410	15,060
1959	14,460	10,820	6,702	9,222	15,350	11,740	8,671	6,181	7,233	8,155	6,448	3,885	9,036
1960	2,896	1,353	8,741	15,790	15,810	17,910	12,390	10,090	7,293	5,072	2,907	2,745	8,573
1961	5,736	3,062	5,394	9,418	10,549	20.458	20,037	13,297	10,287	11,270	8,210	7,490	10,434
1962	5,362	9,842	18,758	22,800	21,761	21,639	17,463	13,171	13,263	11,319	9,550	8,810	14,478
1963	8,364	3,471	1,620	2,640	3,326	8,833	4,154	5,207	4,889	7,143	5,243	6,664	5,129
1964	5,958	2,359	4,125	7,662	7,737	15,731	18,090	16,600	9,990	9,707	10,931	7,427	9,693
1965	5,046	8,649	15,026	13,326	16,982	16,955	17,603	9,292	6,777	6,173	4,114	4,352	10,357
1966	6,435	1,790	1,830	2,798	15,340	11,780	5,824	9,920	9,257	5,293	4,998	3,444	6,504
1967	5,125	3,277	5,242	5,744	3,853	6,653	6,449	10,850	5,983	8,069	8,823	7,372	6,482
1968	7,838	5,012	10,130	21,040	15,660	17,290	17,440	16,740	12,640	11,230	8,395	7,629	12,590
1969	10,326	7,754	18,194	12,931	19,025	13,577	17,290	14,794	11,137	10,264	9,306	9,235	12,819
1970	8,764	6,771	10,914	15,429	14,543	17,219	17,947	14,787	12,963	11,323	10,973	10,310	12,661
Mean	6,703	5,230	8,127	10,485	13,590	14,446	13,632	12,087	9,129	8,666	7,413	7,000	9,705

Table 109 - Observed Mean Discharge in c.f.s., Sta 72885.00, Sunflower River at Sunflower, Miss., 1936-1967

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1936	235	396	223	536	685	402	434	238	178	240	171	182	326
1937	203	198	578	3,367	1,681	1,138	538	593	513	264	210	373	804
1938	741	1,326	868	1,880	1,555	1,237	2,118	449	436	229	286	244	947
1939	224	231	241	1,546	4,130	1,888	3,533	570	453	680	245	230	1,164
1940	231	233	291	346	1,476	1,041	1,548	466	367	1,721	388	214	693
1941	196	670	1,579	1,212	728	1,090	945	473	220	511	230	186	669
1942	253	1,334	417	536	532	1,719	3,340	936	368	253	206	185	839
1943	181	266	520	596	941	2,592	709	337	381	201	170	169	588
1944	163	225	193	486	1,706	2,244	3,749	2,154	559	217	208	277	1,015
1945	184	186	702	3,979	1,692	3,865	2,138	1,168	319	448	478	352	1,292
1946	542	622	1,032	5,203	4,355	2,314	1,086	1,279	1,336	1,365	398	243	1,647
1947	223	595	468	3,045	1,128	1,393	1,685	1,020	1,845	330	220	201	1,012
1948	186	631	757	970	4,221	3,964	1,904	894	550	316	733	229	1,279
1949	199	1,666	1,686	3,303	2,389	1,503	1,908	1,118	1,867	488	315	235	1,389
1950	717	364	1,288	4,335	4,613	4,127	1,455	754	573	292	281	647	1,620
1951	226	272	1,590	3,539	3,130	1,424	1,537	604	293	593	196	184	1,132
1952	178	210	1,729	1,602	2,206	1,560	1,657	752	500	210	171	172	912
1953	163	174	238	334	2,351	2,905	1,272	4,902	1,196	458	208	160	1,196
1954	137	148	429	1,519	928	253	357	1,760	204	112	100	108	504
1955	121	120	116	240	978	2,026	3,763	652	215	213	132	116	724
1956	128	124	250	127	4,326	990	1,035	430	282	100	91	101	665
1957	93	100	263	1,092	3,402	854	1,719	631	767	699	133	466	851
1958	1,133	3,629	2,748	1,254	654	1,421	1,429	6,078	1,228	2,076	1,425	2,347	2,118
1959	1,792	866	401	1,087	2,411	735	800	273	256	415	303	276	801
1960	362	221	1,196	1,468	1,187	2,591	357	486	250	151	149	180	716
1961	224	270	534	1,235	2,615	3,947	3,410	672	529	798	275	163	1,222
1962	124	1,252	3,429	3,450	1,747	1,429	1,565	329	900	363	181	354	1,260
1963	206	134	191	188	312	1,316	363	717	243	1,052	367	146	436
1964	107	119	472	969	496	1,790	2,928	1,521	209	141	192	130	756
1965	146	343	2,748	943	3,225	1,646	1,142	381	206	132	135	216	938
1966	109	104	113	123	3,694	314	369	1,139	151	137	189	182	552
1967	300	191	1,006	609	566	603	482	1,930	311	195	149	121	538
Mean	313	538	884	1,597	2,064	1,760	1,602	1,115	553	481	279	293	956

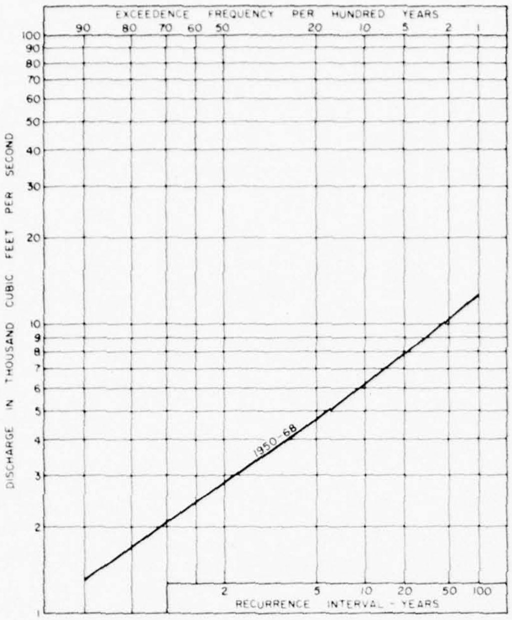

FIGURE 175 7-2660 FREQUENCY CURVE OF ANNUAL PEAK FLOWS CANE CREEK AT NEW ALBANY, MISS.

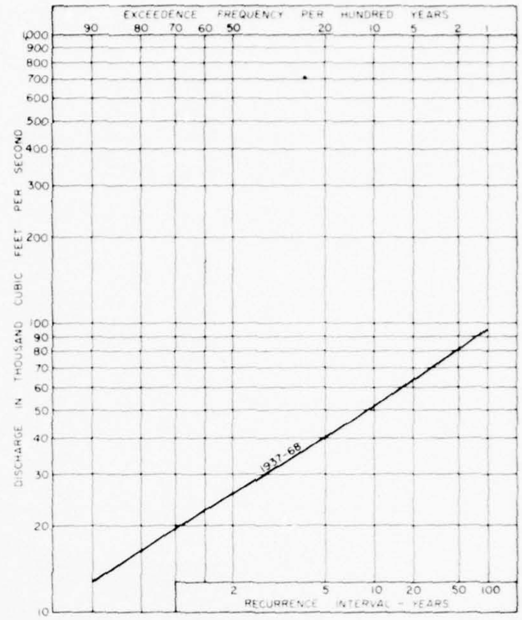

FIGURE 176 7-2680 FREQUENCY CURVE OF ANNUAL PEAK FLOWS LITTLE TALLAHATCHIE RIVER AT ETTA, MISS.

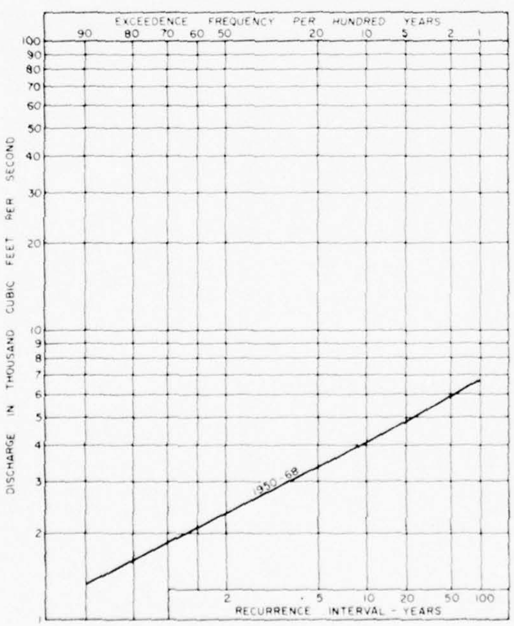

FIGURE 177 7-2710 FREQUENCY CURVE OF ANNUAL PEAK FLOWS CLEAR CREEK NEAR OXFORD, MISS.

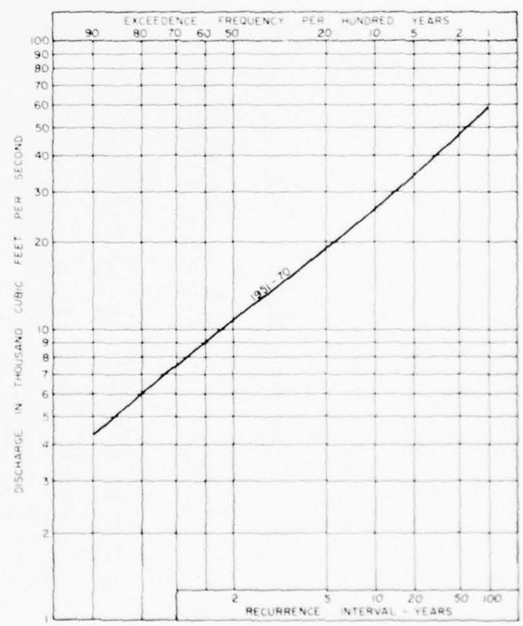

FIGURE 178 7-2740 FREQUENCY CURVE OF ANNUAL PEAK FLOWS YOCONA RIVER AT OXFORD, MISS.

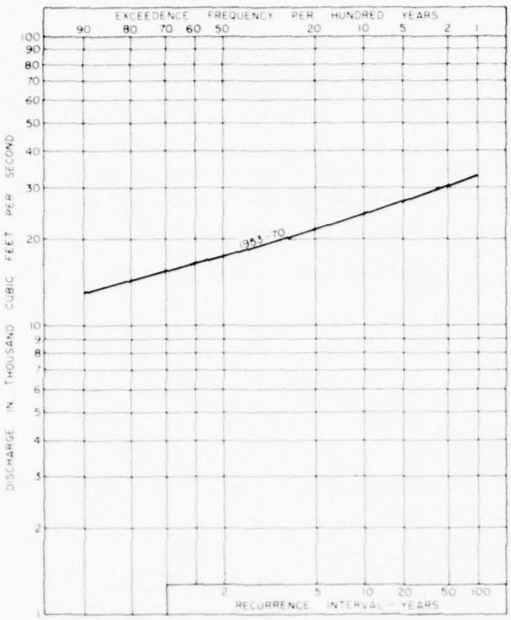

FIGURE 179 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-2810 TALLAHATCHIE RIVER AT SWAN LAKE, MISS

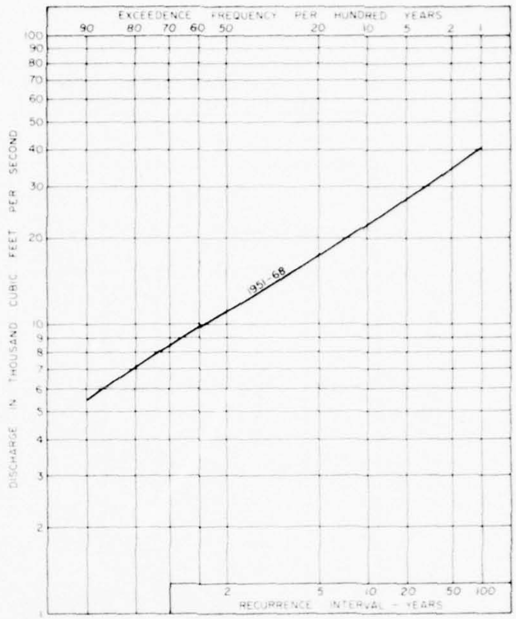

FIGURE 180 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-2820 YALOBUSHA RIVER AT CALHOUN CITY, MISS.

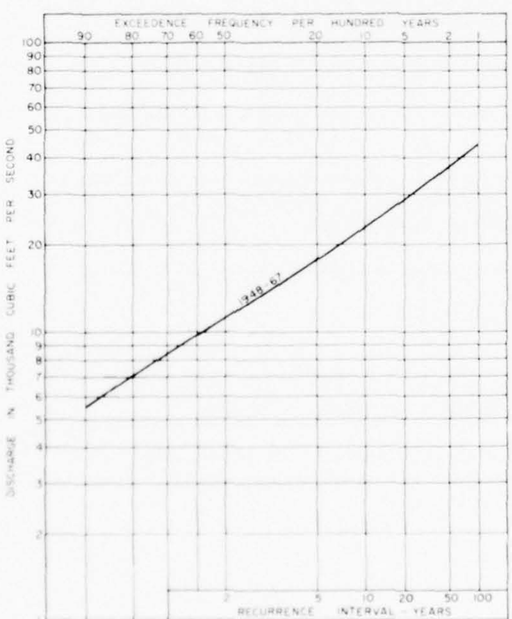

FIGURE 181 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-2830 SKUNA RIVER AT BRUCE, MISS.

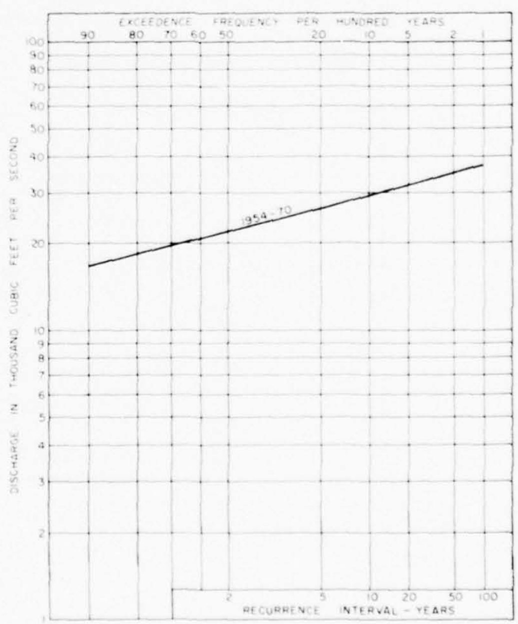

FIGURE 182 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-2870 YAZOO RIVER AT GREENWOOD, MISS.

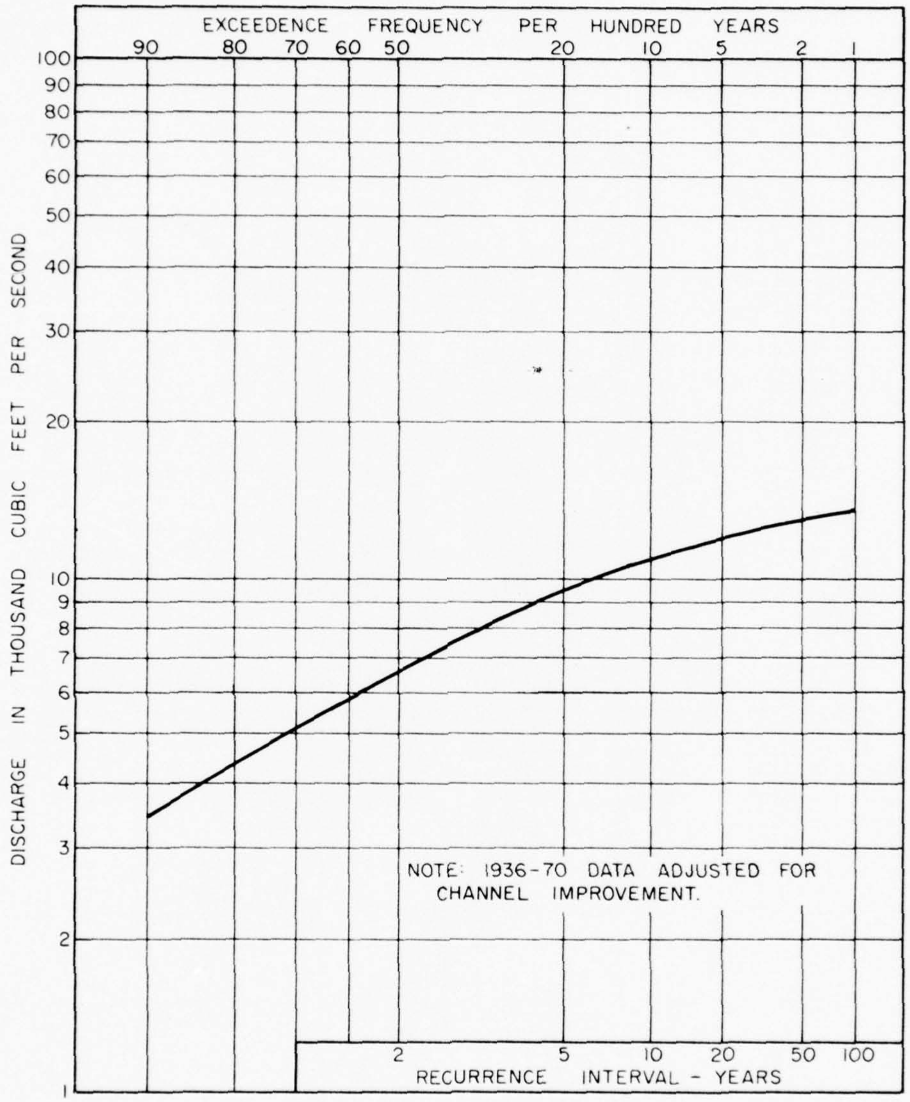

FIGURE 183 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-2885 SUNFLOWER RIVER AT SUNFLOWER, MISS.

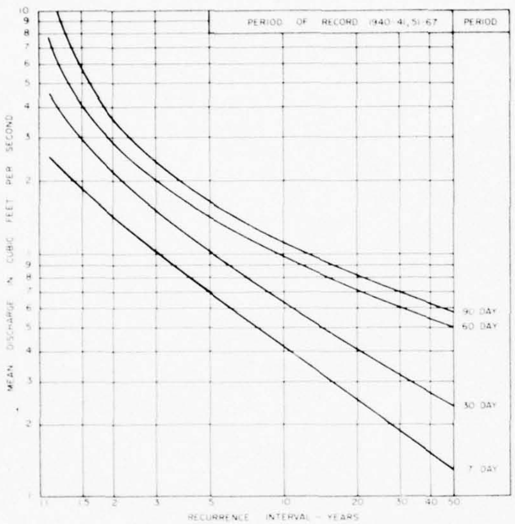

FIGURE 184 LOW FLOW FREQUENCY CURVES
7-2660 CANE CREEK AT NEW ALBANY, MISS

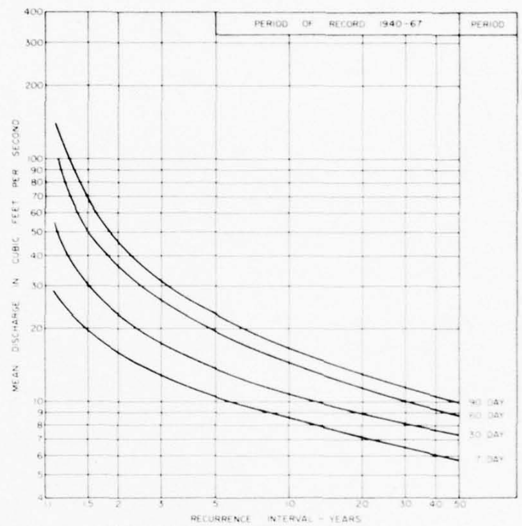

FIGURE 185 LOW FLOW FREQUENCY CURVES
7-2680 LITTLE TALLAHATCHIE RIVER AT ETTA, MISS

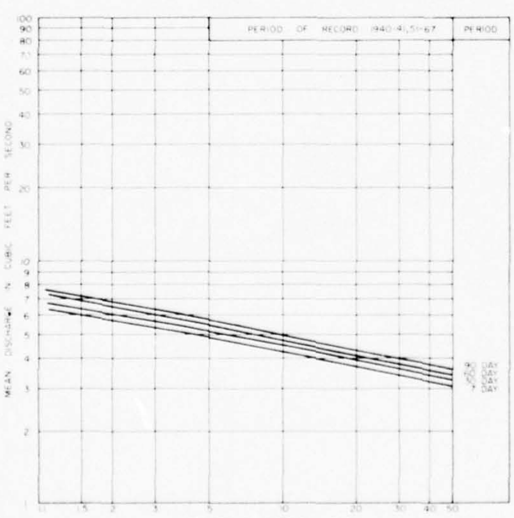

FIGURE 186 LOW FLOW FREQUENCY CURVES
7-2710 CLEAR CREEK NEAR OXFORD, MISS

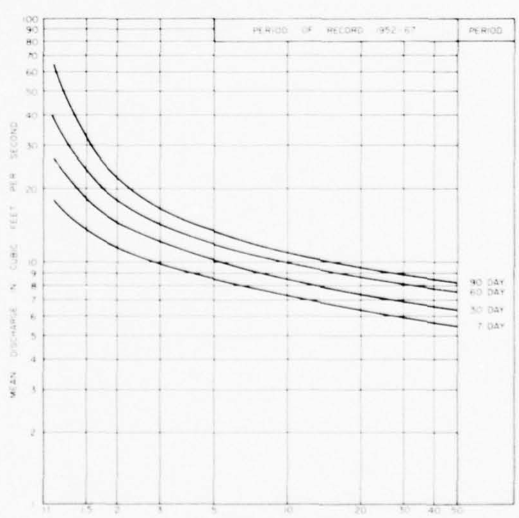

FIGURE 187 LOW FLOW FREQUENCY CURVES
7-2740 YOCONA RIVER AT OXFORD, MISS

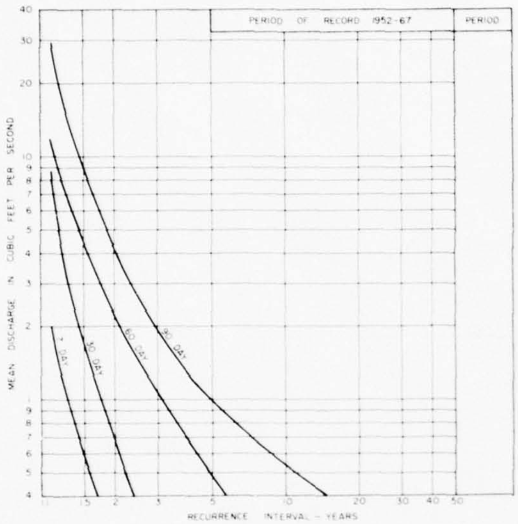

FIGURE 188 LOW FLOW FREQUENCY CURVES
7-2820 YALOBUSHA RIVER AT CALHOUN CITY, MISS

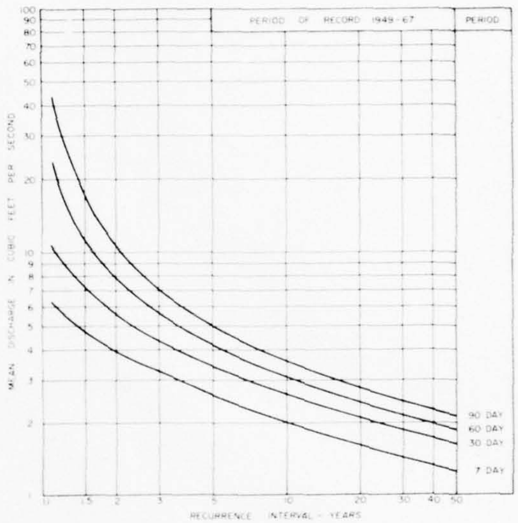

FIGURE 189 LOW FLOW FREQUENCY CURVES
7-2830 SKUNA RIVER AT BRUCE, MISS

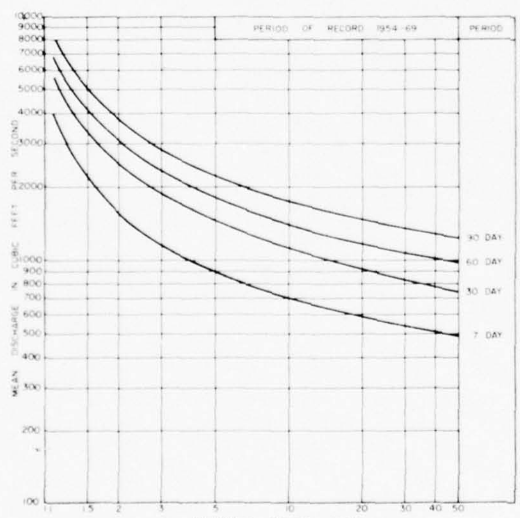

FIGURE 190 LOW FLOW FREQUENCY CURVES
7-2870 YAZOO RIVER AT GREENWOOD, MISS

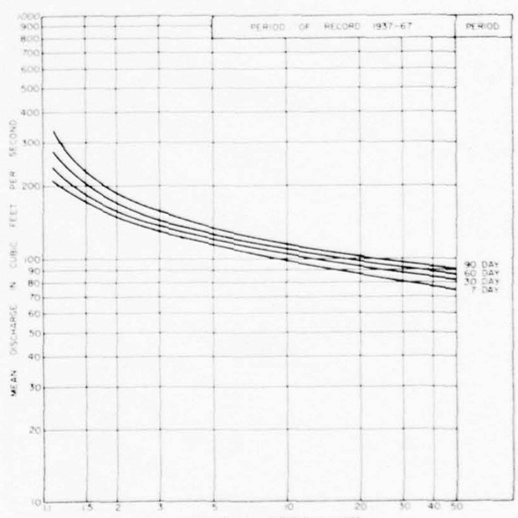

FIGURE 191 LOW FLOW FREQUENCY CURVES
7-2885 SUNFLOWER RIVER AT SUNFLOWER, MISS

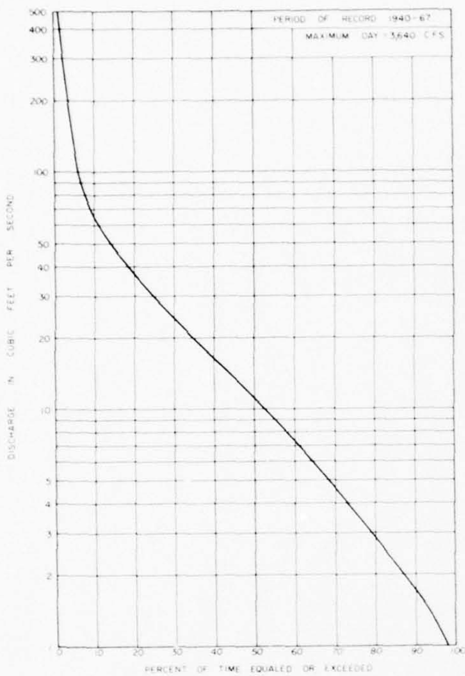

FIGURE 192 DURATION CURVE
7-2660 CANE CREEK NEAR NEW ALBANY, MISS.

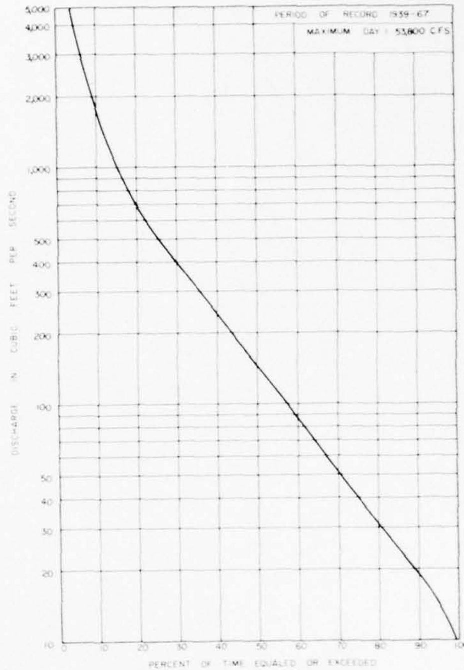

FIGURE 193 DURATION CURVE
7-2680 LITTLE TALLAHATCHIE RIVER AT ETTA, MISS.

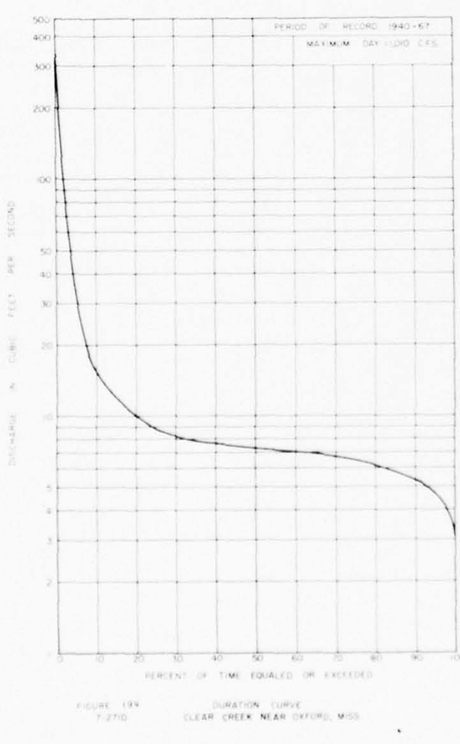

FIGURE 194 DURATION CURVE
7-2710 CLEAR CREEK NEAR OXFORD, MISS.

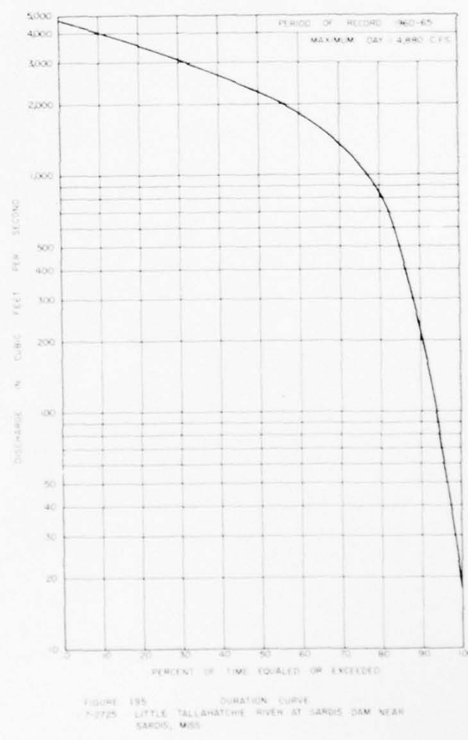

FIGURE 195 DURATION CURVE
7-2725 LITTLE TALLAHATCHIE RIVER AT SARDIS DAM NEAR SARDIS, MISS.

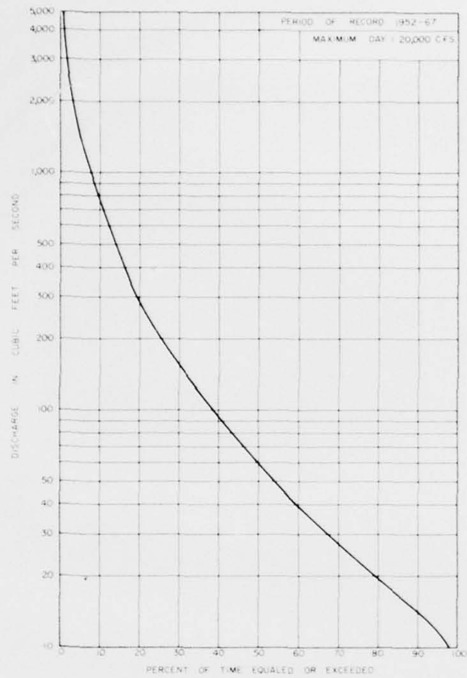

FIGURE 196 DURATION CURVE
7-2740 YOCONA RIVER NEAR OXFORD, MISS.

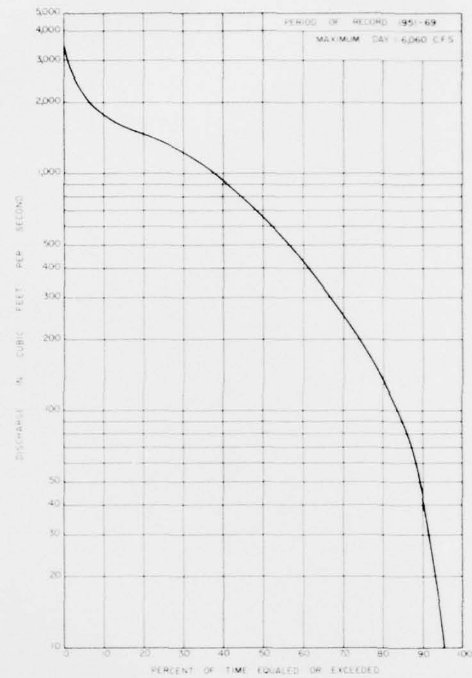

FIGURE 197 DURATION CURVE
7-2750 YOCONA RIVER AT ENID DAM NEAR ENID, MISS.

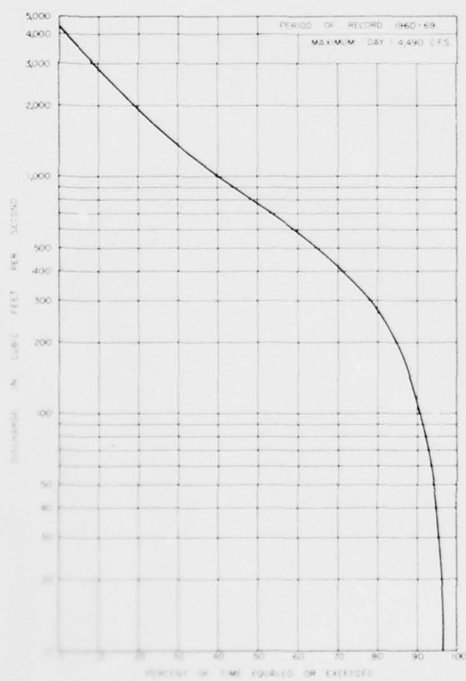

FIGURE 198 DURATION CURVE
[illegible] COLDWATER RIVER AT ARKABUTLA DAM NEAR
ARKABUTLA, MISS.

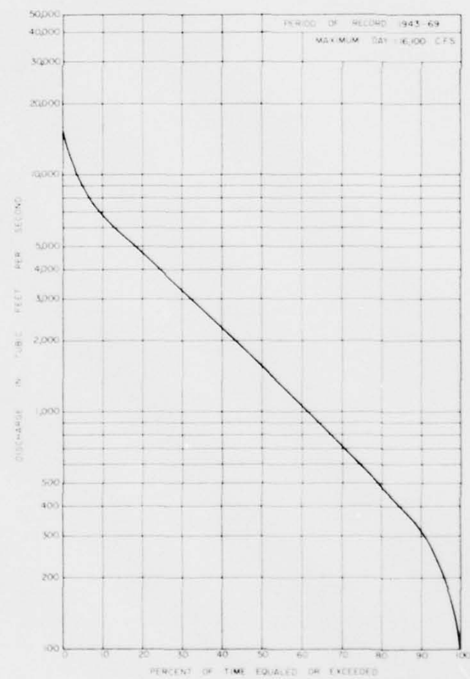

FIGURE 199 DURATION CURVE
7-2800 TALLAHATCHIE RIVER NEAR LAMBERT, MISS.

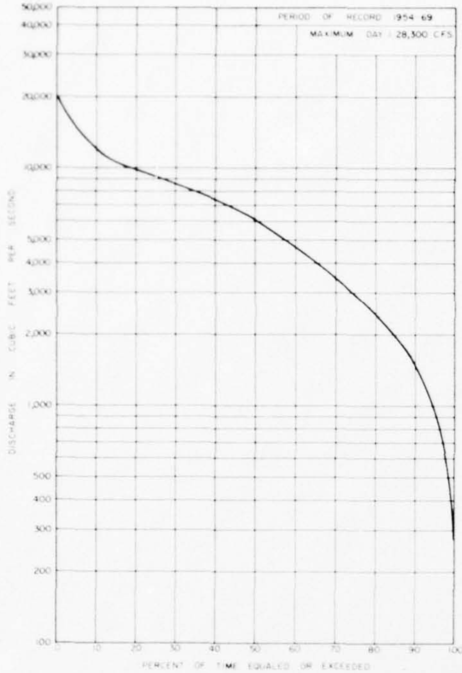

FIGURE 200 DURATION CURVE
7-2810 TALLAHATCHIE RIVER AT SWAN LAKE, MISS

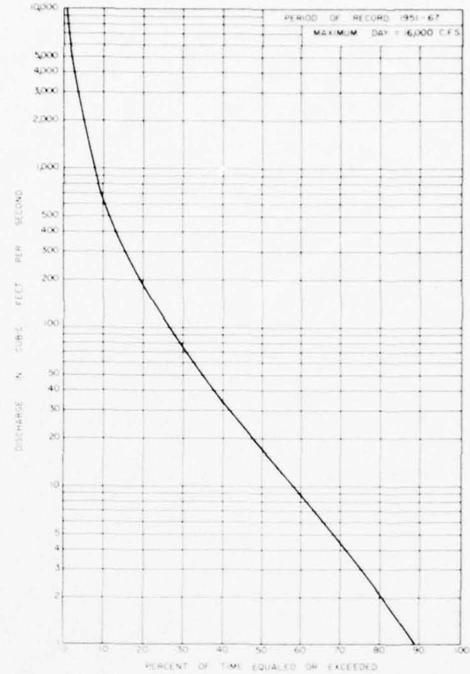

FIGURE 201 DURATION CURVE
7-2820 YALOBUSHA RIVER AT CALHOUN CITY, MISS

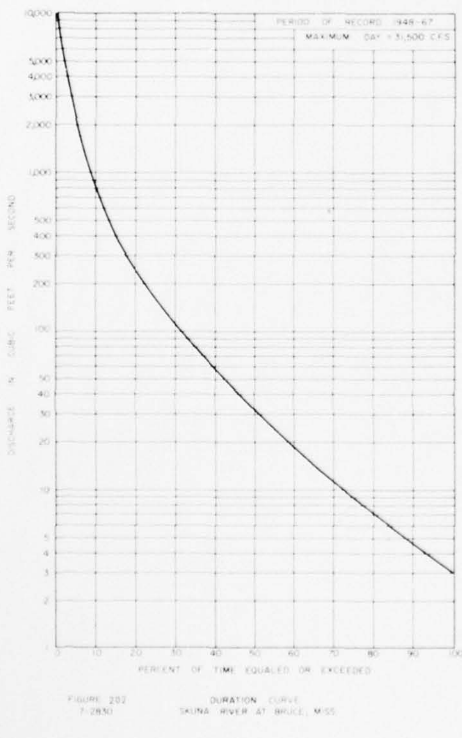

FIGURE 202 DURATION CURVE
7-2830 SKUNA RIVER AT BRUCE, MISS

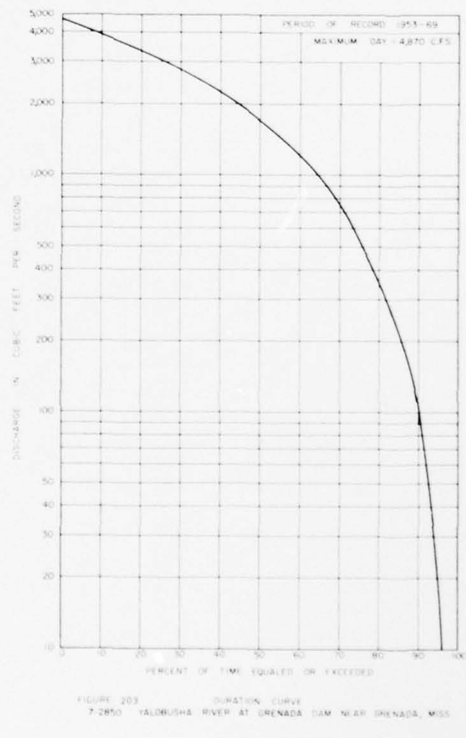

FIGURE 203 DURATION CURVE
7-2850 YALOBUSHA RIVER AT GRENADA DAM NEAR GRENADA, MISS

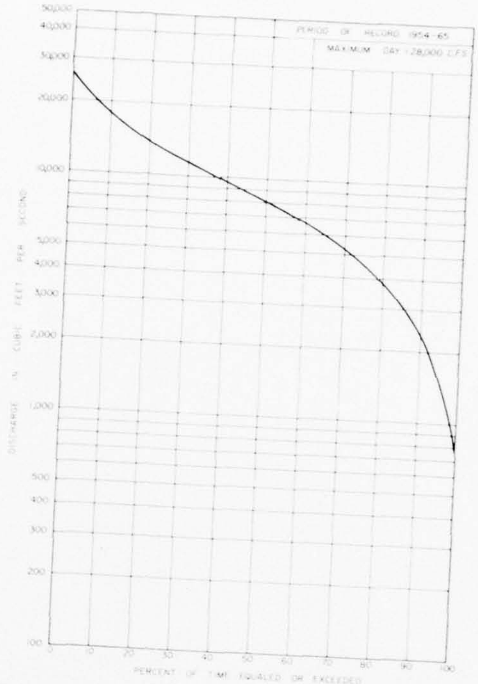

FIGURE 204
7-2870
DURATION CURVE
YAZOO RIVER AT GREENWOOD, MISS.

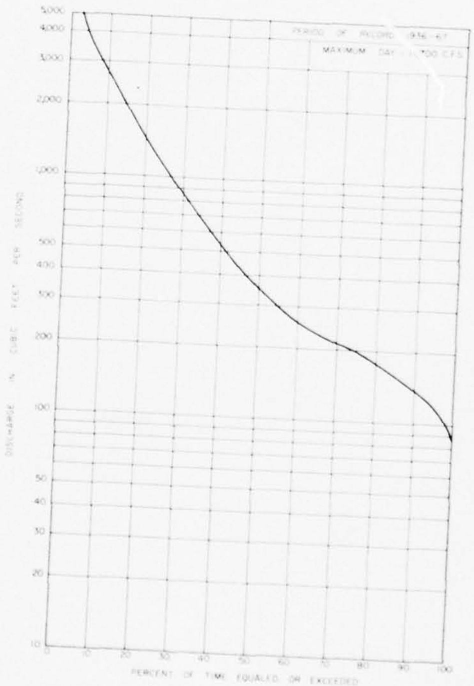

FIGURE 205
7-2885
DURATION CURVE
SUNFLOWER RIVER AT SUNFLOWER, MISS.

Table 110 - Dependable Yield at Sta 72660.00, Cane Creek near New Albany, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1951-1969 Mean
1	1963-1963	18	47.0
2	1966-1967	25	65.3
3	1954-1956	26	68.8
4	1953-1956	30	78.4
5	1963-1967	30	78.9
6	1963-1968	32	84.9
7	1954-1960	32	85.8
8	1959-1966	33	86.8
9	1959-1967	32	85.3
10	1959-1968	33	88.3
19	1951-1969	38	100.0

Table 111 - Dependable Yield at Sta 72680.00, Tallahatchie River at Etta, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1939-1969 Mean
1	1954-1954	292	36.6
2	1942-1943	416	52.2
3	1941-1943	427	53.6
4	1940-1943	456	57.2
5	1940-1944	508	63.7
6	1940-1945	555	69.7
7	1939-1945	631	79.2
8	1953-1960	675	84.8
9	1953-1961	692	86.9
10	1952-1961	707	88.8
31	1939-1969	797	100.0

Table 112 - Dependable Yield at Sta 72710.00, Clear Creek near Oxford, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1951-1969 Mean
1	1967-1967	9	59.3
2	1966-1967	10	69.2
3	1965-1967	11	76.8
4	1964-1967	11	77.4
5	1963-1967	12	79.0
6	1963-1968	13	85.6
7	1963-1969	13	86.6
8	1960-1967	12	84.8
9	1959-1967	12	83.4
10	1958-1967	13	86.3
19	1951-1969	15	100.0

Table 113 - Dependable Yield at Sta 72725.00, Tallahatchie River at Sardis Dam near Sardis, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1941-1970 Mean
1	1963-1963	1,208	54.7
2	1966-1967	1,343	60.8
3	1941-1943	1,344	60.9
4	1941-1944	1,484	67.3
5	1963-1967	1,686	76.4
6	1963-1968	1,768	80.1
7	1963-1969	1,901	86.1
8	1960-1967	1,912	86.6
9	1959-1967	1,912	86.6
10	1959-1968	1,938	87.8
30	1941-1970	2,207	100.0

Table 114 - Dependable Yield at Sta 72740.00, Yocona River near Oxford, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1952-1969 Mean
1	1954-1954	140	42.5
2	1966-1967	215	65.3
3	1965-1967	233	70.8
4	1963-1966	257	78.1
5	1963-1967	249	75.8
6	1963-1968	279	84.8
7	1963-1969	293	88.9
8	1960-1967	308	93.7
9	1959-1967	301	91.5
10	1959-1968	314	95.4
18	1952-1969	329	100.0

Table 115 - Dependable Yield at Sta 72750.00, Yocona River at Enid Dam, near Enid, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1952-1970 Mean
1	1967-1967	408	48.3
2	1966-1967	483	57.2
3	1965-1967	570	67.6
4	1964-1967	617	73.2
5	1963-1967	601	71.2
6	1963-1968	669	79.3
7	1963-1969	708	83.9
8	1963-1970	757	89.7
9	1953-1961	772	91.4
10	1952-1961	781	92.5
19	1952-1970	844	100.0

Table 116 - Dependable Yield at Sta 72785.00, Coldwater River at Arkabutla Dam, near Arkabutla, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1943-1970 Mean
1	1963-1963	630	47.1
2	1963-1964	834	62.4
3	1966-1968	984	73.6
4	1963-1966	981	73.3
5	1963-1967	987	73.8
6	1963-1968	1,028	76.9
7	1961-1967	1,066	79.7
8	1960-1967	1,061	79.3
9	1959-1967	1,069	79.9
10	1959-1968	1,085	81.1
28	1943-1970	1,337	100.0

Table 117 - Dependable Yield at Sta 72800.00, Tallahatchie River near Lambert, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1940-1970 Mean
1	1940-1940	950	36.1
2	1940-1941	989	37.6
3	1940-1942	1,457	55.4
4	1940-1943	1,537	58.4
5	1940-1944	1,702	64.7
6	1940-1945	2,016	76.6
7	1962-1968	2,177	82.7
8	1960-1967	2,177	82.7
9	1959-1967	2,184	83.0
10	1959-1968	2,228	84.7
31	1940-1970	2,631	100.0

Table 118 - Dependable Yield at Sta 72810.00, Tallahatchie River at Swan Lake, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1940-1970 Mean
1	1941-1941	3,561	49.7
2	1940-1941	3,619	50.5
3	1940-1942	4,234	59.1
4	1940-1943	4,225	59.0
5	1940-1944	4,682	65.3
6	1940-1945	5,499	76.7
7	1963-1969	6,320	88.2
8	1960-1967	6,275	87.6
9	1959-1967	6,253	87.2
10	1959-1968	6,410	89.4
31	1940-1970	7,167	100.0

Table 119 - Dependable Yield at Sta 72820.00, Yalobusha River at Calhoun City, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1951-1969 Mean
1	1954-1954	91	27.4
2	1966-1967	132	39.9
3	1952-1954	172	51.8
4	1952-1955	200	60.4
5	1952-1956	217	65.4
6	1952-1957	234	70.6
7	1951-1957	280	84.6
8	1952-1959	287	86.7
9	1952-1960	298	89.9
10	1952-1961	302	91.2
19	1951-1969	331	100.0

Table 120 - Dependable Yield at Sta 72830.00, Skuna River at Bruce, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1948-1969 Mean
1	1967-1967	113	32.1
2	1966-1967	147	41.9
3	1965-1967	167	47.4
4	1964-1967	228	64.9
5	1963-1967	219	62.3
6	1963-1968	254	72.3
7	1963-1969	254	72.3
8	1962-1969	295	83.8
9	1959-1967	296	84.2
10	1960-1969	305	86.8
22	1948-1969	352	100.0

Table 121 - Dependable Yield at Sta 72850.00, Yalobusha River at Grenada Dam, near Grenada, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1954-1970 Mean
1	1954-1954	506	30.2
2	1966-1967	705	42.2
3	1965-1967	910	54.4
4	1965-1968	1,203	71.9
5	1963-1967	1,153	69.0
6	1963-1968	1,308	78.2
7	1963-1969	1,398	83.6
8	1963-1970	1,456	87.1
9	1959-1967	1,620	96.9
10	1959-1968	1,666	99.6
17	1954-1970	1,673	100.0

Table 122 - Dependable Yield at Sta 72870.00, Yazoo River at Greenwood, Miss., 1955-1970

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1955-1970 Mean
1	1963-1963	5,129	51.3
2	1966-1967	6,493	65.0
3	1965-1967	7,781	77.8
4	1963-1966	7,920	79.2
5	1963-1967	7,633	76.4
6	1963-1968	8,459	84.6
7	1961-1967	9,011	90.2
8	1960-1967	8,956	89.6
9	1959-1967	8,965	89.7
10	1959-1968	9,327	93.3
16	1955-1970	9,995	100.0

Table 123 - Dependable Yield at Sta 72885.00, Sunflower River at Sunflower, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1936-1970 Mean
1	1936-1936	326	32.7
2	1966-1967	545	54.6
3	1954-1956	631	63.3
4	1963-1966	670	67.2
5	1963-1967	644	64.6
6	1963-1968	725	72.7
7	1963-1969	776	77.9
8	1936-1943	753	75.6
9	1936-1944	782	78.5
10	1936-1945	833	83.6
35	1936-1970	997	100.0

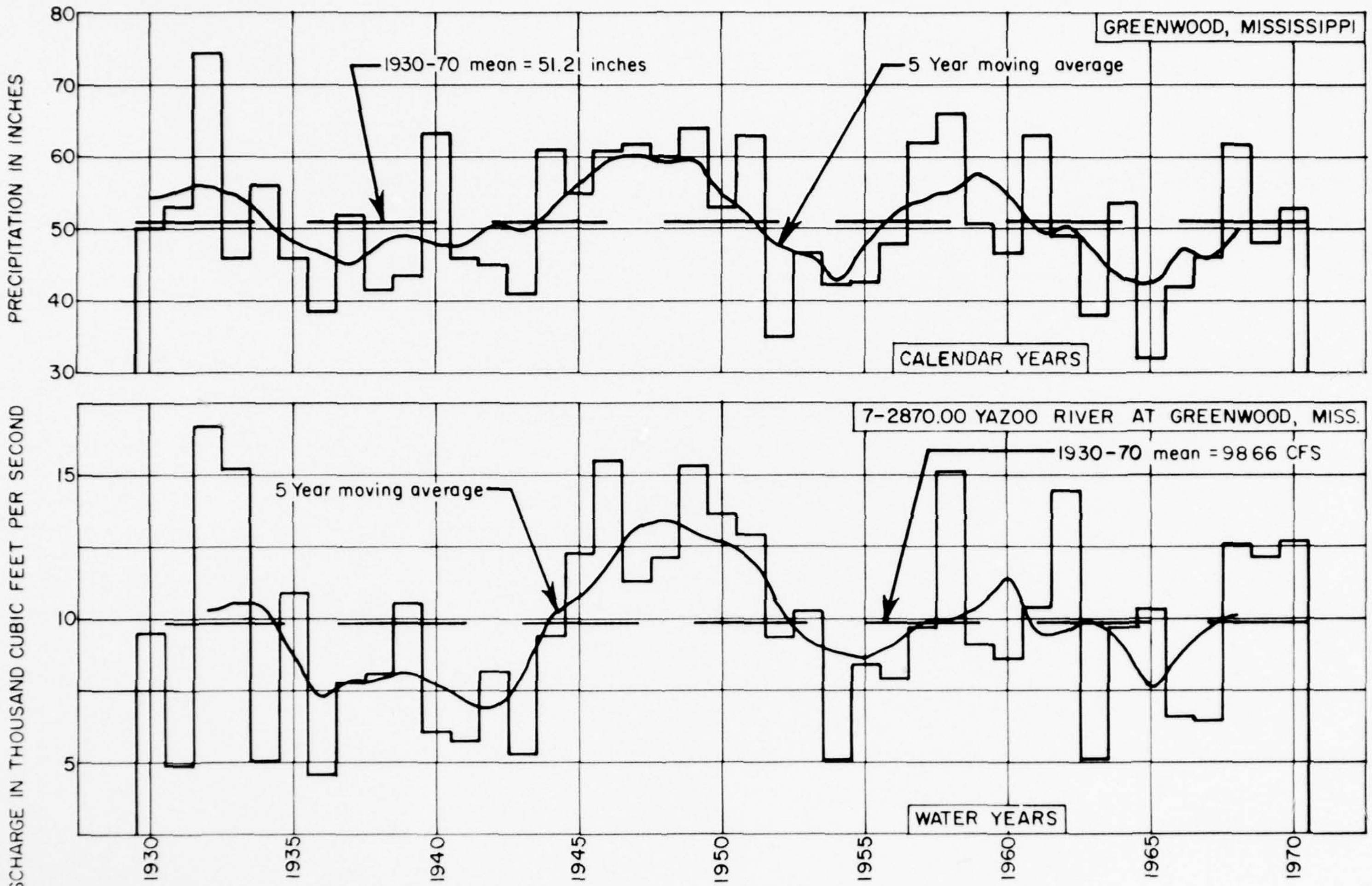

FIGURE 206 LONG-TERM VARIATION IN PRECIPITATION AND STREAMFLOW

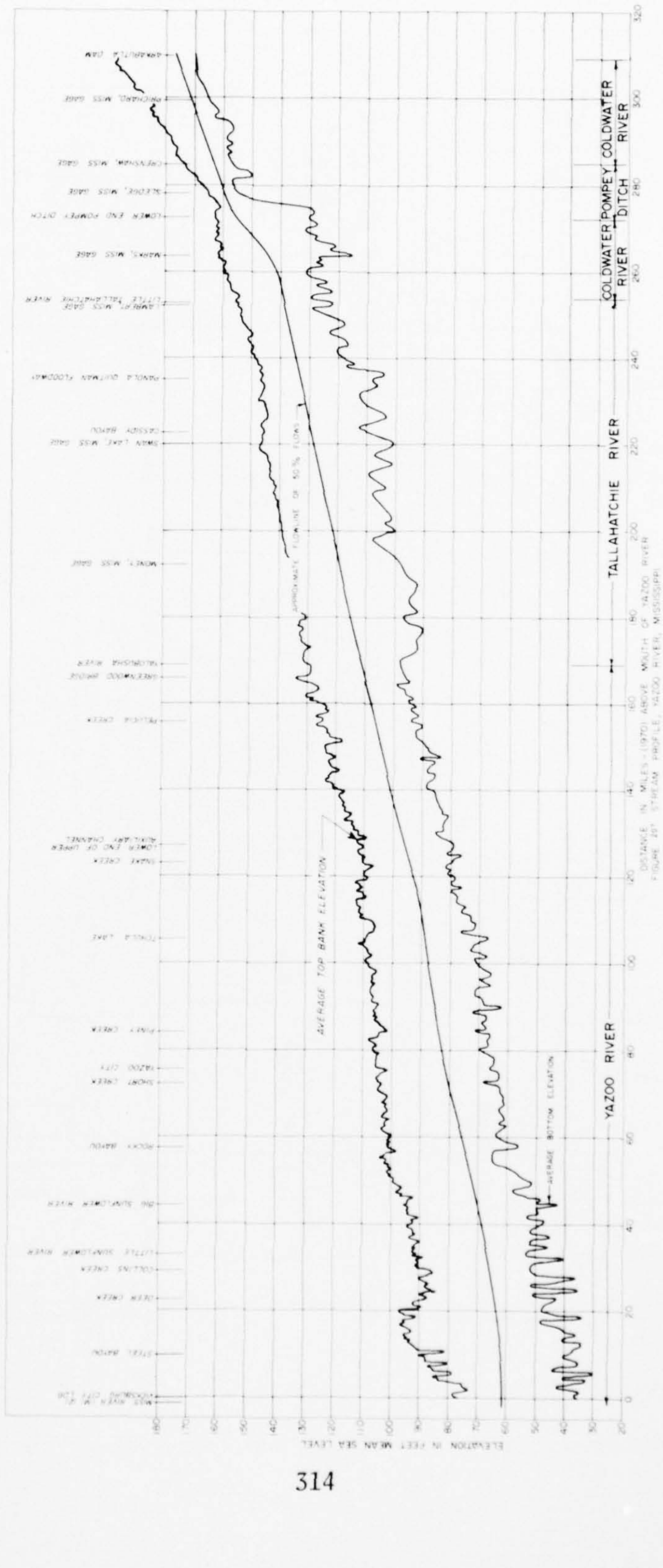

FIGURE 20. STREAM PROFILE, YAZOO RIVER, MISSISSIPPI

Table 124 - Chemical Analyses of Low-Flow Surface Waters in WRPA 4 in the Lower Mississippi Region, Milligrams Per Liter

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
02435900 Chiwapa Creek near Pontotoc, Pontotoc County, Miss. (drainage area, 6 sq mi)																			
Ripley Formation, Prairie Bluff Chalk and Clayton Formation	11- 4-59	3.8	6.4	0.08	42	3.4	2.1	1.0	143	4.6	3.0	0.1	0.4	133	119	2	231	7.5	7
	5-31-60	5.5	2.3	.00	35	2.2	2.2	.7	113	4.6	2.5	.1	.3	106	96	4	191	7.4	10
07269000 North Tippah Creek near Ripley, Tippah County, Miss. (drainage area, 20.0 sq mi)																			
Porters Creek Clay and Wilcox Group (Mississippi)	11- 3-59	1.8	14	0.22	4.6	4.0	2.5	1.5	23	11	4.0	0.1	0.4	53	28	9	70	6.8	15
	5-30-60	2.5	5.5	.00	5.3	3.1	2.5	1.0	18	13	3.5	.0	.4	43	26	10	73	6.5	7
07283000 Skuna River at Bruce, Calhoun County, Miss. (drainage area, 254 sq mi)																			
	11-19-59	15	11	0.62	5.7	4.2	9.4	2.6	26	19	10	0.1	0.6	76	32	10	116	6.7	45
07282000 Yalobusha River at Calhoun City, Calhoun County, Miss. (drainage area, 305 sq mi)																			
	11-19-59	4.1	8.6	0.47	4.5	3.5	13	2.9	25	15	15	0.1	0.8	76	26	5	123	6.8	45
	5-31-60	5.1	6.6	.06	6.8	4.5	15	1.5	18	32	16	.1	.4	92	36	20	153	6.6	20
07283200 Persimmon Creek near Bruce, Calhoun County, Miss. (drainage area, 20 sq mi)																			
Wilcox Group (Mississippi)	11- 4-59	2.1	11	0.23	4.9	3.5	5.7	2.6	41	3.4	4.0	0.2	0.4	56	26	0	83	7.1	25
	5-31-60	4.3	2.9	.00	4.8	3.5	7.0	1.8	36	6.0	5.0	.1	.4	50	26	0	92	6.4	20
07268500 Cypress Creek near Etta, Lafayette County, Miss. (drainage area, 28.5 sq mi)																			
Wilcox Group	11- 3-59	4.2	10	0.11	2.1	2.6	3.7	1.1	25	0.2	3.2	0.0	0.5	36	16	0	54	6.9	10
	5-20-60	6.2	9.5	.00	2.4	2.3	3.6	.7	23	2.0	2.0	.1	2.6	36	16	0	46	7.2	10
07274000 Yocona River near Oxford, Lafayette County, Miss. (drainage area, 262 sq mi)																			
Wilcox Group and Tallahatta Formation	11- 3-59	20	8.0	0.13	3.4	1.7	6.2	1.9	25	2.6	5.8	0.1	1.5	43	16	0	67	6.7	25
	5-30-60	69	3.3	.00	3.3	1.8	4.3	1.3	19	4.2	4.0	.0	.3	32	16	0	53	6.5	15
07030390 Grays Creek near Michigan City, Benton County, Miss. (drainage area, 30 sq mi)																			
Tallahatta Formation	11- 3-59	6.6	7.5	0.15	1.7	1.4	2.2	0.8	17	0.0	2.0	0.0	0.8	25	10	0	38	6.6	5
	5-30-60	7.7	3.6	.00	1.5	1.1	2.0	.6	15	.0	1.5	.0	.6	18	8	0	27	6.6	10

Table 124 - Chemical Analyses of Low-Flow Surface Waters in WRPA 4 in the Lower Mississippi Region, Milligrams Per Liter--Continued

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
07270800 Hurricane Creek near Oxford, Lafayette County, Miss. (drainage area, 9 sq mi)																			
Tallahatta Formation--Continued	11- 3-59	9.4	7.0	0.36	1.2	1.3	1.9	0.6	15	0.2	2.0	0.0	0.4	22	8	0	26	6.6	9
	5-30-60	11	2.8	.00	1.1	.8	1.6	.2	11	.0	1.5	.0	.3	14	6	0	22	6.8	10
07284000 Cypress Creek near Coffeeville, Yalobusha County, Miss. (drainage area, 22.3 sq mi)																			
Tallahatta Formation and Sparta Sand	11-20-59	3.9	9.8	0.34	2.7	1.8	4.7	1.1	21	5.2	4.0	0.1	0.5	40	14	0	55	6.6	25
	5-31-60	2.6	6.5	.00	2.7	2.4	4.8	.7	24	2.8	3.5	.0	.4	36	16	0	55	6.4	10
07289270 Hays Creek near Vaiden, Carroll County, Miss. (drainage area, 80 sq mi)																			
Tallahatta Formation, Winona Sand, and Sparta Sand	11-13-59	5.5	10	0.32	8.6	5.3	20	5.0	45	30	16	0.2	2.6	120	44	6	197	6.8	25
	10-25-60	1.2	7.7	.00	11	5.9	26	4.5	62	29	20	.4	6.0	142	52	0	235	6.8	5
07280500 North Fork Tillatoba Creek near Charleston, Tallahatchie County, Miss. (drainage area, 43.7 sq mi)																			
Sparta Sand	11-20-59	5.2	12	0.57	5.5	3.3	7.0	2.5	44	0.6	5.2	0.2	0.6	60	27	0	90	6.9	50
	5-31-60	5.2	11	.01	5.4	2.9	7.8	1.2	42	3.2	5.0	.1	.5	58	26	0	91	7.2	6
07288570 Quiver River near Doddsville, Sunflower County, Miss. (drainage area, 292 sq mi)																			
Quaternary alluvium (Mississippi River)	11-20-59	18	6.0	0.00	19	7.9	6.8	9.1	94	13	8.0	0.2	0.7	117	80	3	199	7.3	30
	10-25-60	28	4.4	.00	17	5.4	5.1	5.9	84	9.0	3.2	.3	1.1	92	64	0	165	6.9	17

GROUND WATER

WRPA 4 comprises parts of the Mississippi Alluvial Plain, Loess Hills, North Central Plateau, Flatwoods, and Pontotoc Ridge. The area is nearly equally divided between the Yazoo Basin lowland of the Mississippi Alluvial Plain and the uplands of the East Gulf Coastal Plain.

The oldest geologic units exposed in the area, of Upper Cretaceous age, crop out in Union and Pontotoc Counties. The Midway, Wilcox, and Claiborne Groups underlie most of the area, including the Yazoo Basin where they are covered by Mississippi River alluvium. The Jackson Group underlies the alluvium in the southern and southwestern part of the Yazoo Basin. The Forest Hill Sand and Vicksburg Group crop out in Warren and southwestern Yazoo Counties, and the Catahoula Sandstone is exposed in places in central and southern Warren County. Most of the upland outcrop areas of the Claiborne and younger Tertiary deposits are blanketed by Quaternary loess and high terrace deposits.

The major aquifers in WRPA 4 are the lower Wilcox aquifer, Meridian-upper Wilcox aquifer, Sparta Sand, Cockfield Formation, and Mississippi River Valley alluvial aquifer (figure 208). Minor aquifers (or major aquifers classified as minor aquifers because of their limited areal extent in the Lower Mississippi Region) are the Gordo, Eutaw, and Ripley Formations and the Coffee Sand in the northeast part of the area; the middle part of the Wilcox Group, the Tallahatta Formation, and the Winona Sand in the northwest, central, and western parts; and the Forest Hill Sand, Mint Spring Marl Member of the Marianna Limestone, Vicksburg Group, and Catahoula Sandstone in the extreme south.

Cretaceous Aquifers

Cretaceous aquifers yield fresh water in Benton, Calhoun, Lafayette, Marshall, Pontotoc, and Union Counties. The Gordo Formation is the principal source of ground water in Calhoun and Pontotoc Counties and is also used in the southeastern parts of Lafayette and Union Counties. Water from the Gordo is commonly suitable for municipal use without treatment; however, the dissolved-solids content exceeds 500 mg/l in much of the area where it is used. The Eutaw Formation is available in approximately the same areas as the Gordo but, due to low yields to wells and to the high mineral content of the water, it is not generally used for municipal or industrial supplies. The largest withdrawals from the Eutaw, about 0.8 mgd, are made at New Albany, Union County, Miss., where the water is of good quality. The Coffee Sand, a source of water in Benton, Lafayette, Marshall, Pontotoc, and Union Counties, is a low-yielding aquifer but the quality of water is generally good. The Ripley Formation is a source of water for small- to moderate-capacity wells as far west as northeastern Calhoun, eastern Lafayette, and Marshall

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

GEOLOGIC SOURCES OF GROUND WATER

WRPA 4

FIGURE 208

Counties and probably contains fresh water in eastern DeSoto County.

Wells in the Gordo Formation in WRPA 4 are among the deepest in the region, averaging more than 2,000 feet in depth in Calhoun County. Wells in the Eutaw, Coffee, and Ripley in the area are commonly 500 to 1,000 feet in depth.

Water use from the Cretaceous aquifers in WRPA 4 was about 4 mgd in 1970. These aquifers are estimated to be capable of yielding about 20 mgd in the area.

Tertiary Aquifers

Lower Wilcox Aquifer

The lower Wilcox aquifer is a major source of ground water in DeSoto, Panola, Quitman, Tate, and Lafayette Counties. The aquifer is of less importance in Benton, Marshall, Union, Calhoun, Carroll, Yalobusha, Grenada, Holmes, and Tallahatchie Counties because the sand beds are commonly thin and irregular; however, it is capable of yielding considerable water at some localities. Water in the lower Wilcox becomes saline in Coahoma, Tallahatchie, Leflore, and Holmes Counties.

The hydraulic characteristics of the lower Wilcox aquifer reflect the gradual thinning of the aquifer from north to south in WRPA 4. In DeSoto County, the coefficient of transmissibility is probably about the same as that at Memphis, Tenn., where it averages about 100,000 gpd per foot. In Grenada, Tallahatchie, and Yalobusha Counties, transmissibilities probably do not exceed 10,000 gpd per foot.

Water from the lower Wilcox aquifer is commonly suitable for most uses without treatment and it is the most desirable source of water for municipal and community water systems in the northwestern part of WRPA 4. The water is soft, a sodium bicarbonate type, and generally is free of objectionable quantities of iron and other constituents.

The maximum depth for wells in the lower Wilcox aquifer will be about 3,000 feet in the southwestern part of the area where the aquifer contains fresh water. Water used from the aquifer in Mississippi in 1970 totalled about 4 mgd; however, declines in the potentiometric surface in DeSoto County indicate that withdrawals in the Memphis area (about 16 mgd) are replenished partly by inflow from northwestern Mississippi.

The lower Wilcox aquifer is estimated to be capable of yielding about 60 mgd in WRPA 4 without an excessive decline in water levels.

Minor Wilcox Aquifers

Irregular sand beds in the middle part of the Wilcox Group are

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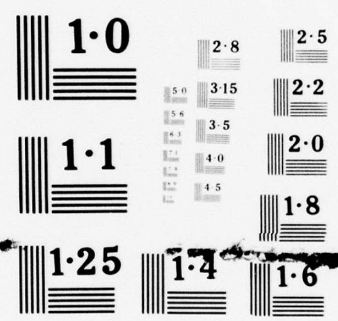

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thick enough in some places in WRPA 4 to be ground water sources for public and industrial water supplies; however, the presence of these thicker sand beds is not predictable. Several moderate-capacity wells now tap middle Wilcox sands in Panola and adjoining counties. At several sites, however, the middle Wilcox sands are not utilized as a source for public supplies because the water is corrosive or contains excessive iron in solution.

It is estimated that the minor Wilcox aquifers are capable of yielding about 8 mgd. Further study may show the aquifer to be more extensive than is now indicated.

Meridian-Upper Wilcox Aquifer

The Meridian-upper Wilcox aquifer is a widely used source of ground water in WRPA 4, a result of areal extent, high water levels, good quality water, and favorable hydraulic characteristics.

Results of aquifer tests conducted in WRPA 4 indicate coefficients of transmissibility ranging from 1,100 to 70,000 gpd per foot. Some large wells yield more than 2,000 gpm and yields of 1,000 gpm are not unusual; however, the Meridian-upper Wilcox aquifer in some areas is not capable of large yields.

Where the Meridian-upper Wilcox aquifer occurs at shallow to moderate depths (200 to 1,000 feet) the water is low in dissolved solids but generally requires treatment for pH adjustment or iron removal. In areas further down the dip, the water is a soft sodium bicarbonate type that is suitable for general use without treatment. In the southwestern part of WRPA 4, the water is a sodium chloride type.

High water levels prevail in the Meridian-upper Wilcox aquifer, although declines have been large in many areas and significant elsewhere. Initial water level declines were the result of the large number of uncontrolled flowing wells made in the aquifer in the Mississippi Alluvial Plain. Later declines were the result of the general development of the aquifer for municipal and industrial supplies. Declines are especially large in DeSoto County, Miss., as a result of pumping at Memphis from the Memphis Sand, the lower part of which is equivalent to the Meridian-upper Wilcox aquifer. Water levels in some parts of WRPA 4 are still high; for example, in part of Yazoo County, Miss., the potentiometric surface is more than 100 feet above land surface.

Withdrawals in WRPA 4 in 1970 amounted to about 30 mgd. The aquifer is capable of yielding over 70 mgd in the area without serious consequences if a reasonable distribution of withdrawals is made.

Tallahatta Formation and Winona Sand

The Tallahatta Formation is composed of thin-bedded sand and clay and includes irregular thick beds of sand. The Winona Sand is a marly

or silty sand overlying the Tallahatta Formation. Both formations are water-bearing and are primarily used as sources of ground water for domestic and other small wells. A few public water supply wells in the northern part of WRPA 4 obtain water from the Tallahatta Formation.

Water from the Tallahatta Formation and Winona Sand is commonly higher in dissolved solids than is water from the Meridian-upper Wilcox aquifer or the Sparta Sand; however, the water is generally suitable for most uses without treatment.

Water use from the Tallahatta Formation and Winona Sand is estimated to be about 0.3 mgd. Future work may show that the Tallahatta Formation may be capable of yielding large quantities of water in the northern part of WRPA 4.

Sparta Sand

The Sparta Sand crops out in the uplands in the northeastern part of WRPA 4. The regional dip in WRPA 4 is westward toward the axis of the Mississippi embayment. The formation thickens to the west and south, attaining a maximum thickness of about 800 feet in the extreme southern part of the area. The Sparta is composed of irregularly bedded sand and clay. In places, the lenticular sand beds attain a thickness of more than 100 feet and at some localities several thick sand beds are present; however, all sands in the Sparta are interconnected when considered on an areal basis. The Sparta Sand merges into the upper part of the Memphis Sand in the extreme northern part of the area.

Transmissibility values for the Sparta Sand in WRPA 4 range from less than 10,000 to 94,000 gpd per foot, and yields of more than 2000 gpm from wells have been reported. The Sparta is the principal source of ground water for municipal and industrial supplies at Cleveland, Clarksdale, Yazoo City, and numerous smaller municipalities in these areas. The largest withdrawals from the Sparta are in the Yazoo City area, where about 7 mgd is pumped. The present total pumpage from the Sparta is about 30 mgd. Although water levels have declined throughout WRPA 4, the Sparta is estimated to be capable of yielding about 140 mgd in WRPA 4.

The quality of water in the Sparta Sand is generally good although in the northern part of the area treatment for iron removal is needed in some places. In other areas, where the aquifer occurs at shallow to moderate depths, the water is corrosive due to high carbon dioxide content. In the southern part of the area, the dissolved-solids content ranges from 500 to 1,000 mg/l.

Cockfield Formation

The Cockfield Formation crops out in the uplands of Carroll, Holmes, and Yazoo Counties. The formation underlies and is hydraulically connected to the Mississippi River Valley alluvial aquifer in the central

part of the Yazoo Basin. In the southern part of the Yazoo Basin, the Yazoo Clay of the Jackson Group forms a confining layer above the Cockfield. In WRPA 4, the formation attains a maximum thickness of about 600 feet in Washington County, Miss.

The Cockfield Formation is generally composed of irregular beds of fine sand and clay; however, in some localities the hydraulic characteristics are favorable and wells are capable of large yields. Transmissibility values in WRPA 4 range from 4,000 to 160,000 gpd per foot. The largest reported yield for wells is at Greenville where individual wells yield more than 1,500 gpm.

Water from the Cockfield is generally a soft sodium bicarbonate type. Color is a troublesome characteristic in some localities, and the dissolved-solids content is high in the southwestern part of the area.

The largest withdrawals of water from the Cockfield are at Greenville where about 14 mgd is produced [111]. About 2 mgd is pumped at Leland, Miss. The total withdrawal from the Cockfield Formation in WRPA 4 is about 17 mgd, and the estimated potential yield of the aquifer is about 25 mgd.

Forest Hill Sand, Vicksburg Group, and Catahoula Sandstone

The Forest Hill Sand and Vicksburg Group crop out in Warren County and extreme southwestern Yazoo County. The Catahoula Sandstone in WRPA 4 is restricted to central and southern Warren County. All are water bearing to varying degrees, but none is capable of yielding large quantities of water to wells in WRPA 4. The Forest Hill and Catahoula are capable in some localities of yielding a maximum of 200 to 300 gpm to individual wells, but average yields are much lower. The Mint Spring Marl Member (of the Marianna Limestone) and the marls and limestones of the overlying Vicksburg Group in places yield up to about 10 gpm to domestic and other small wells.

Water quality is quite variable in the Forest Hill Sand and Catahoula Sandstone. At places, the water requires treatment for hardness, excessive iron, or corrosiveness. Water from the Mint Spring Marl Member is generally suitable for domestic use without treatment.

Quaternary Aquifers

Mississippi River Valley Alluvial Aquifer

The Mississippi River Valley alluvial aquifer, which underlies the entire Yazoo Basin, is the only significant Quaternary aquifer in WRPA 4. The alluvium averages about 140 feet in thickness, and the lower sand and gravel part forms an aquifer averaging about 80 feet in thickness. The aquifer is replenished principally by infiltration of precipitation where the upper part of the deposits is permeable. Lateral movement of

ground water recharges areas overlain by impermeable clay and silt.

The average permeability of the sand and gravel forming the aquifer is estimated to be about 2,000 gpd per square foot, and values for transmissibility range up to about 250,000 gpd per foot. Wells can be constructed to yield as much as 5,000 gpm and wells yielding 2,500 gpm for irrigation and industrial use are common; however, the composition of the alluvial deposit is very variable and large wells are not feasible everywhere.

Water from the Mississippi River Valley alluvial aquifer in WRPA 4 is moderately mineralized and hard, and generally contains several milligrams per liter of iron in solution. It is suitable for irrigation and cooling. With treatment, the water in many places is suitable for municipal and other uses. The largest municipality in the Lower Mississippi Region using water from the Mississippi River alluvium is Vicksburg.

Most of the total of 267 mgd now withdrawn from the alluvial aquifer is for irrigation, principally of rice. About 50 mgd is used for cooling and about 7 mgd is produced for the municipal water supply at Vicksburg. The estimated potential yield from the aquifer in WRPA 4 is slightly more than 1,700 mgd; however, this potential yield would be much larger if well fields were located along the Mississippi River or near major streams where hydraulic conditions favor infiltration.

Effects of Ground Water Withdrawals and Management Considerations

Water level declines have been observed in all aquifers in WRPA 4 except the Mississippi River Valley alluvial aquifer. The alluvial aquifer, replenished each winter and spring by precipitation, recovers to about the same level each year under present pumping conditions. The only places where cones of depressions are relatively permanent are at localities where water is pumped for thermoelectric cooling.

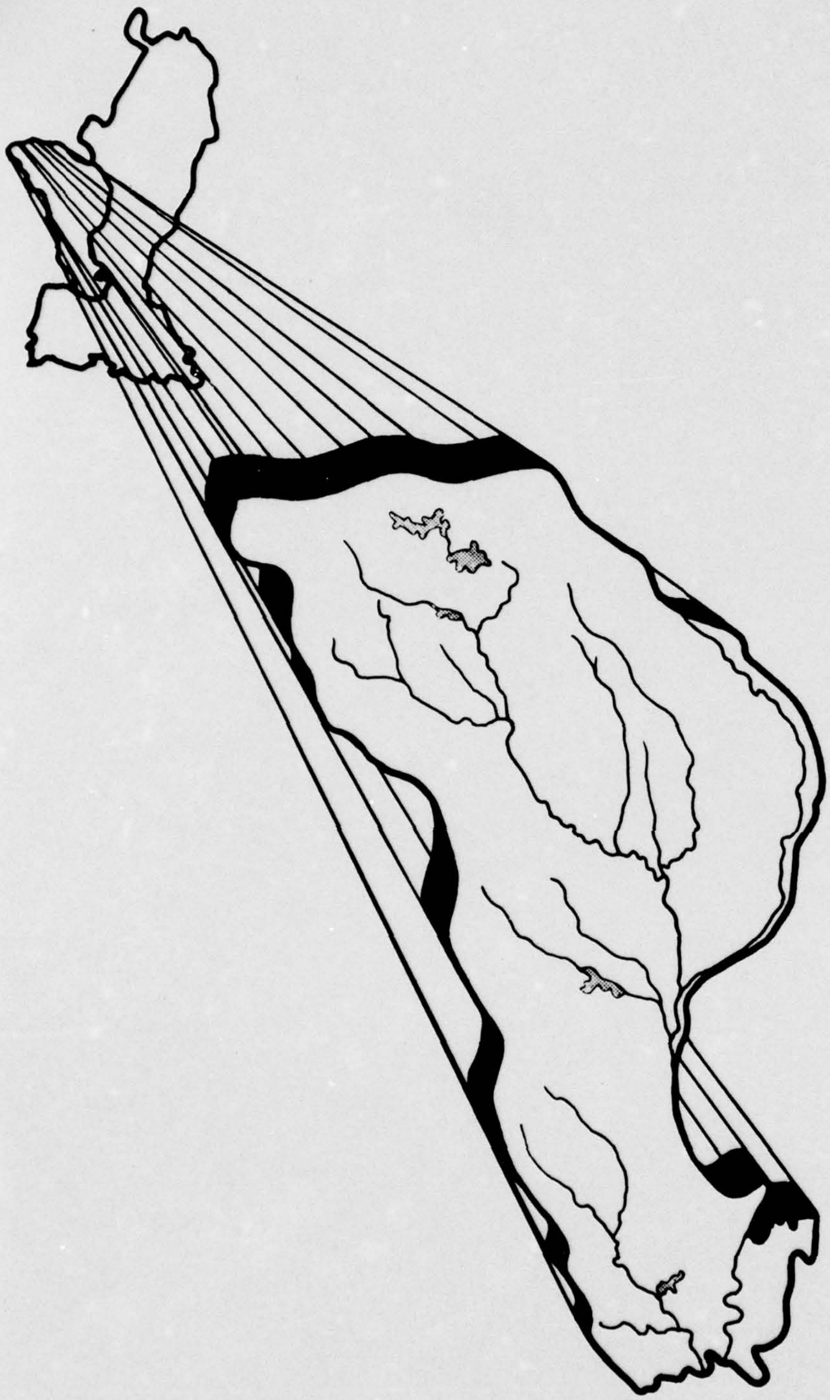
The largest water level declines in the Lower Wilcox aquifer are the result of pumping in the Memphis area. The most pronounced effect of this withdrawal in WRPA 4 is in DeSoto County, Miss. A cone of depression of regional extent has developed in the Meridian-upper Wilcox aquifer in the central part of WRPA 4 as a result of the large number of uncontrolled flowing artesian wells in the area. In the northern part of the area, the withdrawals from the Memphis Sand are resulting in a significant water level decline in the Meridian-upper Wilcox. The average decline in the Sparta Sand has amounted to about 30 feet, and there is a large cone of depression at Yazoo City, Miss. Water levels in the Cockfield Formation have declined gradually as a result of withdrawals by many small wells in the southern and western part of the area. The

only pronounced water level decline in the Cockfield Formation is in the Greenville-Leland area.

Water level declines in artesian aquifers in the area are significant but not serious. Water level declines in the alluvial aquifers are seasonal except in a few areas where water is pumped for cooling or industrial use (Greenville, Greenwood, and Yazoo City, for example).

The Mississippi River Valley alluvial aquifer is the source for nearly 85 percent of the potential ground water supply in WRPA 4. The aquifer needs to be studied in detail for planning the optimum development of water resources in the area. Among factors that need to be determined are recharge rates, stream low-flow characteristics, and potential aquifer yield under planned conditions of withdrawal. The hydraulic characteristics of the aquifer vary considerably from place to place with the result that some areas have a much higher potential for ground water development than other areas. The high yielding areas need to be identified. The feasibility of developing well fields in high yielding zones along the Mississippi River and the lower reaches of the Yazoo and Sunflower Rivers needs to be studied.

The artesian aquifers in WRPA 4 are low yielding in comparison with the Mississippi River Valley alluvial aquifer. Detailed studies of the individual aquifers are needed to determine the optimum yield of ground water and to plan the best utilization of the water.



WRPA 5

W R P A 5

INTRODUCTION

The largest study area of the Lower Mississippi Region is WRPA 5. It covers about 20,413 square miles, or about 20 percent of the entire area of the region. About 59 percent of the area lies within the State of Arkansas with the remaining 41 percent in Louisiana. Water covers 392 square miles, or about 1.5 percent of the area, and the remaining 20,021 square miles are land areas.

WRPA 5 is bounded on the north by the watershed boundary of the Arkansas River, on the south and west by the Red River watershed boundary, and on the east by the east bank Ouachita River levees and the Bayou Bartholomew watershed boundary. The length of the area is about four times its average width, thereby constituting a fairly long, narrow basin. Figure 209 shows the WRPA boundaries, stream patterns, State lines, major cities, and other pertinent features of the area.

Runoff from WRPA 5 averaged about 13.6 inches per year, or 20,440 c.f.s., during the past 20 years, which is low compared with that for the rest of the region. The area's maximum annual runoff is about 2.3 times its average annual runoff, and the minimum is about 30 percent of the average annual runoff.

The principal stream in WRPA 5 is the Ouachita-Black River. It carries the flow from all of the tributary streams in the area between the Mississippi River levees and the Red River watershed boundary in Louisiana and Arkansas. The mean annual flow at its mouth is about 26,800 c.f.s., or about 14.8 inches of runoff per year. These figures include flows from the Boeuf and Tensas Rivers of WRPA 6. The mean annual runoff along the main stem of the Ouachita River varies from 18 inches at Arkadelphia, Ark., and 16 inches at Camden, Ark., to 13.7 inches at Monroe, La.

The Ouachita River is formed in the Ouachita Mountains near Mena, Ark., and flows through rugged terrain about 160 miles eastward through the pools of Lake Ouachita, Lake Hamilton, and Lake Catherine, to the vicinity of Malvern, Ark.; then southerly for about 95 miles through hilly upland areas to Camden, Ark. It then flows southeasterly about 132 miles through wide bottoms in a hilly terrain and southerly 224 miles through the alluvial valley of the Mississippi River to enter the Red River at mile 36. 1/ The stream enters the State of Louisiana at mile 237 and is called the Black River below mile 57. 2/

1/ Mileage measured from mouth of Red River.
2/ Mileage measured from mouth of Black River.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

MEAN ANNUAL RUNOFF IN INCHES

WRPA 5

FIGURE 209

Stream gradients on the Ouachita River average about 12 feet per mile in the first 80 miles from the source and 4 feet per mile in the next 80 miles. From Malvern, Ark., to Lock and Dam 8, the river slopes decrease from 2.5 to 0.4 foot per mile. From here to the mouth, the average stream gradient is about 0.1 to 0.2 foot per mile. A profile showing these gradients is presented in figure 299. The width of the main channel varies from 300 feet near Malvern, Ark., to 800 feet near Lock and Dam 8, to about 1,000 feet in the vicinity of Jonesville, La. The floodplain along the river is about 1 to 7 miles in width in the reaches above Lock and Dam 8 and about 4 to 25 miles in width in the lower reaches.

Major tributaries of the Ouachita River in WRPA 5 are the Caddo River, Little Missouri River, Saline River, Bayou Bartholomew, Bayou D'Arbonne, and Little River. The Caddo River rises in Montgomery County, Ark., and flows in a southeastward direction through 78 miles of rugged terrain into the Ouachita River. DeGray Dam, a multipurpose hydroelectric and flood-control dam, controls 453 square miles of the Caddo's 490-square-mile drainage area. The Little Missouri River flows southeasterly from Polk County, Ark., about 150 miles to the Ouachita River. Its total drainage area is 2,080 square miles, 237 of which are regulated by the Narrows Dam which forms Lake Greeson at mile 105. The Saline River is formed in Saline County, Ark., flows southerly about 200 miles to the Ouachita River at mile 255, and controls about 3,270 square miles of drainage area. Bayou Bartholomew has its source in Jefferson County, Ark., and flows along the western boundaries of the alluvial valley of the Mississippi River about 370 miles to its confluence with the Ouachita River at mile 210. It has a total drainage area of 1,665 square miles at its mouth [101]. Bayou D'Arbonne is formed in Union Parish, La., by the confluence of Corney Bayou and Little Bayou D'Arbonne and flows southeasterly about 37 miles through hilly areas to the Ouachita River above Monroe, La. It has a reservoir, D'Arbonne Lake, located at Farmerville, La., which controls 1,607 square miles of the bayou's total drainage area of 1,904 square miles. The Little River, formed by the confluence of the Dugdemona River and Bayou Castor, flows about 60 miles through the Mississippi-Red River backwater area to Catahoula Lake, then eastward through the Catahoula Lake Diversion Canal to the Black River below Jonesville, La.

WRPA 5 can be divided into three topographic sections--the mountain, hill, and delta sections. The mountain section comprises about 15 percent of the total area and lies in the upper reaches of the Ouachita River and its tributaries. This section extends from around Malvern, Ark., approximately at mile 450 of the Ouachita River, to the headwater areas of the basin. The terrain is very rugged and consists of parallel ridges separated by deep valleys with elevations ranging from 400 to 2,000 feet. Most of the area is timbered, except for small areas in the narrow valleys which are farmed. The soils in this section generally

consist of a thin stratum of gravelly clay underlain by shale, sandstone, or limestone deposits.

The hill section extends along the main stem of the Ouachita River from Malvern, Ark., to an area below Lock and Dam 8. This section, which comprises over half of the WRPA, is rolling and hilly land except for the flat bottoms along the river. Elevations range from 500 feet in the uplands to about 100 feet in the broad plains along the river. Upland soils are light sandy loams, and lowlands are sandy or clayey loams underlain by clay.

In the area below Lock and Dam 8, the river enters the alluvial valley of the Mississippi River and traverses bottom lands dissected by numerous swamps, lakes, and bayous. This large low-lying depression, approximately 80 miles in length, extends to the vicinity of Sterlington, La. This area, called the Felsenthal Basin, acts as a natural reservoir by storing water and releasing it in a regulated manner. Below Sterlington, the delta section extends to the mouth of the Black River with a hill area on the western edge of the basin. Below the vicinity of Columbia, La., the Ouachita lies within the Red River backwater area. In this area, the topography is of low relief with surface elevations averaging 35 to 40 feet in the swamp lands [121]. Soils in the area consist of recent alluvial deposits over backswamp clay.

SURFACE WATER

A major portion of the streamflow generated within WRPA 5 originates in the tributary streams of the Ouachita River Basin in Arkansas. Major streams in this area are the main stem Ouachita River, the Caddo River, the Little Missouri River, and the Saline River. The sequence of flows on the Ouachita, Caddo, and Little Missouri Rivers is regulated by the Blakely Mountain Dam, DeGray Dam, and the Narrows Dam, respectively. These flood-control and hydroelectric dams control flows from about one-third of the total drainage area of the Ouachita River at Camden, Ark.; hence, flows at and above Camden are greatly affected by short-term changes in release rates of these tributary reservoirs. Average annual discharge values, however, give a true representation of the surface runoff for the area.

Quantity

The average annual discharge of streams originating in WRPA 5 totals about 20,440 c.f.s.. This averages about 1.0 c.f.s. per square mile, which is a low figure as compared with that for the rest of the region. The above flows do not include the average annual flow of 6,350 c.f.s. which is contributed to the Ouachita-Black River from the Boeuf and Tensas Rivers of WRPA 6 or the 31,000 c.f.s. contributed to the area from the Upper Red River Basin.

Present Utilization

Withdrawals from surface water sources in WRPA 5 during 1970 (about 2,410 c.f.s.) were equivalent to 12 percent of the mean annual flow generated within the area. These withdrawals comprised about 76 percent of all the water used (about 3,185 c.f.s.), with the remaining 24 percent coming from ground water sources. Thermoelectric power production and fish and wildlife enhancement were the two chief sources for which surface water was withdrawn, comprising 69 percent (1,660 c.f.s.) and 15 percent (374 c.f.s.), respectively, of the total withdrawal. Withdrawals of surface water for irrigation of crops (184 c.f.s.) and industrial purposes (136 c.f.s.) accounted for about 13 percent of the total surface water withdrawn.

Major withdrawals from ground water sources in WRPA 5 were for irrigation and industrial purposes. An average of about 385 c.f.s. was withdrawn for irrigation and about 185 c.f.s. for industrial uses. The major part of the water for municipal uses and for the mineral industry in the area was obtained from ground water sources. During 1970, about 1,070 c.f.s., or 33 percent of the total surface and ground water withdrawals from WRPA 5, were consumed. The remaining 2,115 c.f.s. was released and returned to streamflow, thus resulting in a net decrease in the area's streamflow of about 295 c.f.s.

Major consumptive uses of water in the area were for irrigation and fish and wildlife enhancement, which comprised 41 percent and 37 percent, respectively, of the total water consumed. Water consumed for irrigation averaged 440 c.f.s., which comprised 77 percent of the total surface and ground water withdrawn for that purpose. The fish and wildlife industry consumed all the water which was withdrawn for that purpose, or an average of about 394 c.f.s.

Major nonconsumptive uses of water in WRPA 5 are for navigation and recreation. By the use of a system of locks and dams and supplemental releases of water from the tributary reservoirs, navigation on the Ouachita River has been extended to the vicinity of Camden, Ark. Recreation is popular throughout the entire area, with most of the lakes and major streams being used for fishing, boating, and other water sports.

Additional information on the withdrawals of ground and surface water in WRPA 5 during 1970 is given in table 15 of the Regional Summary. This table also presents pertinent data on the consumption of water for various purposes in this WRPA and each of the other areas in the Lower Mississippi Region.

Stream Management

All of the various users of an area's water resources reap the benefits of an efficient method of stream management in the area. In WRPA 5, stream management practices include changes in stream systems by the use of dams for decreasing flood flows and supplementing low flows, the development of levees, channel improvements, the diversion of water for various uses, and the construction of locks and dams for navigational purposes. Some of these practices were begun before records of streamflow were obtained in the area and others have been made so gradually that it would take many subsequent years of record to define their effects on the stream system.

Impoundments. Table 125 gives pertinent data on lakes in WRPA 5 which have a total capacity of 5,000 acre-feet or more [29]. Lake Ouachita (Blakely Mountain Dam) is the largest impoundment in the area, having more storage capacity than all of the other lakes in the area combined.

The operation of the reservoirs used for flood control usually follows a pattern of discharging excess water during the early months of the fall, then maintaining active capacity during the winter and spring months to allow for the storage of runoff from heavy winter and spring rains. Operation to regulate low flows also involves storage of inflow during the flood season from December through May. These flows are then released at a uniform rate from June through November to provide water for navigation, irrigation, municipal and industrial water supply, recreation, and other purposes. The reservoirs used for flood control and

hydroelectric power production have variable short-term effects on river discharge. Power loads cause abrupt changes in the discharges and may cause lower flows during weekends when less power is required.

Table 125 - Reservoirs Having a Total Capacity of 5,000 Acre-Feet or More, WRPA 5

Name	Stream	Total Storage acre-feet	Active Storage acre-feet	Surface Area acres	Use 1/
Lake Ouachita	Ouachita River	2,768,100	1,903,200	48,300	P,F,R
Lake Hamilton	Ouachita River	190,000	119,600	7,200	P
Lake Catherine	Ouachita River	35,400	20,000	1,800	P
DeGray Lake	Caddo River	881,900	620,400	17,000	P,F,M,I,W
Lake Greeson	Little Missouri River	407,900	330,300	9,800	P,F,R
D'Arbonne Lake	Bayou D'Arbonne	130,000	--	15,250	R
Corney Lake	Corney Bayou	8,000	--	2,100	M
Lake Claiborne	Bayou D'Arbonne	100,000	--	6,400	M
Catahoula Lake	Little River	133,000	--	27,000	R
Cheniere Brake Lake	Cheniere Creek	15,000	--	2,600	R
Bayou De L'Outre	Bayou De L'Outre	70,000	--	4,970	R
Lake Winona	Alum Fork	43,000	--	--	M

1/ P-Power, M-Municipal Water Supply, R-Recreation, F-Flood Control, I-Irrigation, W-Industrial.

An interesting feature of the DeGray Dam is the regulating dam below the main dam which serves to eliminate the above-mentioned variable short-term effects on discharge below the reservoir. This regulating basin contains sufficient capacity to provide water supply releases during weekends, when power generation is at a minimum. The dam also contains a reversible turbine with the capability of pumping back into the main reservoir power flows in excess of those required for water supply releases. This pumped storage feature serves to develop the full potential of the DeGray Project for purposes of flood control, water supply, power, navigation, and incidental recreation and conservation [137].

Diversions. There are numerous diversions of water in WRPA 5 for purposes of power production, flood control, irrigation, industrial uses, and fish and wildlife conservation. The diversons for power and

flood control are in the upper part of the area on the Ouachita, Little Missouri, and Caddo Rivers. Small irrigation withdrawals take place above the stations on Bayou Bartholomew at Jones, La., Beekman, La., and Chemin-a-Haut Bayou near Beekman, La. The major part of the municipal and industrial water in the area is pumped from wells; hence, little water is diverted from streams for this purpose. Fish and wildlife conservation uses of water are increasing in the area.

An example of the diversion of water for this purpose is the diversion channel and control structure on Catahoula Lake. This part of the Ouachita-Black River Navigation Project includes facilities for the diversion of flows from Catahoula Lake into the Black River downstream from the Jonesville Lock and Dam. This feature allows for the regulation of water levels on Catahoula Lake which will permit its continued use as a wildlife refuge and resting and feeding area for migratory waterfowl [130].

Channel modification. Throughout WRPA 5, there has been a considerable amount of channel modification which has aided flood control, reduced erosion, and maintained depths adequate for navigation on the Ouachita River. Channel improvements were completed in the Little Missouri River Basin in 1956, which consisted of the construction of 31 cutoffs and channel clearing and snagging in the lower 94 miles of the Little Missouri River and the lower 14 miles of Ozan Creek. The clearing, snagging, enlargement, and construction of cutoffs on Terre Noire Creek were completed in 1948. On Bayou Bartholomew and its tributaries in the vicinity of Pine Bluff, Ark., channel improvements and local protection works were completed in 1954 [129].

Channel modification through the construction of levees and local protection works is extensive in WRPA 5. The Ouachita River levees extend from Bastrop, La., to the south bank of Bayou Bartholomew and the east bank of the Ouachita River to the vicinity of Sandy Bayou, about 74 miles below Monroe, La. Loop levees on the western bank of the river provide protection for the towns of West Monroe, Bawcomville, and Columbia, La., and Calion, Ark.

In the Red River backwater area, construction of loop levees to provide partial flood protection to the Tensas-Cocodrie area has been completed. This 93-mile levee joins the Mississippi River levee at Black Hawk, La., and extends westward and northward along the left banks of the Red, Black, and Tensas Rivers and eastward to tie with high ground near Lake St. John. The Bayou Cocodrie Drainage Structure and an additional 16 smaller structures have been constructed in the Tensas-Cocodrie area to provide interior drainage. About 30 miles of loop levee in the Larto Lake to Jonesville, La., area are complete. This levee will provide protection for two separate areas located in Catahoula and LaSalle Parishes in Louisiana. These areas will be divided by the Catahoula Lake Diversion Channel. The upper levee will be about

58 miles in length and will protect the area between the diversion channel and Jonesville, La. The lower levee will lie below Larto Lake and will be about 20 miles in length. Construction work on these levees was initiated in 1965 and is currently about 38 percent complete [123].

Navigation. One of the most important uses of water in WRPA 5 is for navigational purposes. A 9-foot navigation project is currently under construction on the Ouachita River to provide slack water navigation on the Ouachita and Black Rivers from the mouth of the Red River to Camden, Ark. The locks and dams currently operating on the river to provide the navigation depths and their respective pool elevations are shown on the profile of the Ouachita River in figure 299 [138]. Low flows on the Ouachita River will be augmented for navigational use by releases from the DeGray, Blakely Mountain, and Narrows Lakes in Arkansas. Currently, navigation depths are maintained, when necessary, by dredging.

Streamflow

In this study, various periods of flow were used at the selected gaging stations due to the availability of discharge data at the sites. Periods of record for certain stations were modified to reflect changes in the streamflow characteristics at that station due to changes in stream management, diversions, channel improvements, locks and dams, and reservoirs which regulate flows in the upper tributaries. For each of the selected stations, the selected period of record provides reasonably good data for statistical analysis and study in this report.

Measurement facilities. Streamflow data at 33 sites in WRPA 5 were selected for presentation in this section. The streamflow at these sites is considered to be representative of the various drainage and hydrologic conditions which currently exist in the area. Locations of the selected sites are shown in figure 209, a map of the mean annual runoff for the area, and are identified by U. S. Geological Survey station numbers. On this map, the lines of equal runoff which cross the Ouachita River do not reflect the runoff for the river at these points, but instead reflect the average annual runoff for the smaller tributary streams in the immediate vicinity. Table 126 is a summary of the streamflow data at each of the selected sites and presents such data as the controlling agency, the drainage area, period of record, gage datum, high and low stages and flows, and other pertinent facts about the station.

Average discharge for WRPA 5. A graphical representation of the average monthly discharge generated within WRPA 5 is shown in figure 210. This figure also presents the maximum monthly, minimum monthly, and 20 percent and 80 percent duration flows by months for the area. These curves are a reflection of discharge at the mouth of the Black River, less the flows from the Boeuf and Tensas Rivers of WRPA 6, and represent the major part of the flows originating in WRPA 5. A map of isopleths

Table 126 - Streamflow Summary for Selected Sites, WRPA 5

Stream	Station	Agency	Station No.	Gage Datum (feet m.s.l.)	Drainage Area (square mile)	Period of Record 1/	Annual Flows, c.f.s. Mean	Annual Flows, c.f.s. Maximum	Annual Flows, c.f.s. Minimum	Momentary Flows, c.f.s. Maximum	Momentary Flows, c.f.s. Minimum	Stage Data (feet m.s.l.) Highest	Stage Data (feet m.s.l.) Lowest
Ouachita River	Mount Ida, Ark.	USGS	73560	655.14	410	1942-70	708	1,518	260	57,300	2	687.3	656.1
South Fork Ouachita River	Mount Ida, Ark.	USGS	73565	612.05	64	1949-70	92	148	32	20,000	0	627.1	613.1
Ouachita River	Blakely Mountain Dam near Hot Springs, Ark.	USCE	73575.01	0.00	1,105	1953-70	1,317	2,585	305	9,550	20	403.7	389.3
Ouachita River	Malvern, Ark.	USGS	73595	228.05	1,562	1954-69	2,042	3,732	743	110,000	35	254.1	228.4
Caddo River	Alpine, Ark	USCE	73598	394.85	312	1939-70	510	877	197	85,000	4	430.5	394.4
Ouachita River	Arkadelphia, Ark.	USCE	73600	160.30	2,311	1954-70	3,068	5,342	1,133	162,000	159	190.4	163.4
Little Missouri	Narrows Dam near Murfreesboro, Ark.	USCE	73605.01	0.00	237	1950-70	399	691	138	5,210	10	405.4	398.7
Little Missouri	Murfreesboro, Ark.	USGS	73610	324.28	380	1952-69	579	997	203	31,200	4	340.1	325.3
Ozan Creek	McCaskill, Ark.	USGS	73612	281.07	148	1962-69	184	328	76	18,900	0	301.0	DRY
Antoine River	Antoine, Ark.	USGS	73615	229.33	181	1955-69	243	471	133	35,500	0	258.1	230.9
Little Missouri	Boughton, Ark.	USCE	73616	182.13	1,068	1952-70	1,377	2,477	509	66,000	16	209.2	184.4
Ouachita River	Camden, Ark.	USCE	73620	71.69	5,391	1953-70	6,638	11,492	2,390	183,000	407	116.5	74.4
Smackover Creek	Smackover, Ark.	USCE	73621	97.56	377	1962-70	321	694	94	21,400	0	118.8	98.1
Saline River	Benton, Ark.	USGS	73630	260.91	569	1951-69	735	1,217	280	100,000	0	290.6	261.5
Hurricane Creek	Sheridan, Ark.	USGS	73633	200.00	204	1962-69	196	337	43	18,100	0	216.0	204.3
Saline River	Rye, Ark.	USGS	73635	97.06	2,062	1938-69	2,553	5,173	.758	74,500	3	128.5	100.9
Ouachita River	Ark.-La. State Line	USGS	73641	44.09	10,787	1959-69	--	--	--	--	494	87.1	50.7
Bayou Bartholomew	McGehee, Ark.	USGS	73641.5	121.48	692	1957-69	632	1,466	195	6,870	8	146.0	118.7
Bayou Bartholomew	Jones, La.	USGS	73642	79.21	1,187	1958-69	1,173	2,540	323	6,680	32	107.4	79.6
Chemin-a-Haut Bayou	Beekman, La.	USGS	73643	76.08	271	1956-69	256	961	22	29,500	0	104.3	86.4
Bayou de Loutre	Laran, La.	USGS	73647	112.34	141	1956-68	166	456	76	22,600	1	132.6	113.3
Bayou D'Arbonne	Dubach, La.	USGS	73650	83.25	355	1941-68	407	880	57	26,400	0	107.1	DRY
Middle Fork Bayou D'Arbonne	Bernice, La.	USGS	73655	97.08	178	1941-57	224	406	68	28,000	0	111.0	DRY
Cornie Bayou	Three Creeks, Ark.	USGS	73658	--	180	1956-69	157	449	31	35,800	0	--	--
Three Creek	Three Creeks, Ark.	USGS	73659	155.63	50	1956-69	52	132	12	11,300	0	165.0	--
Little Cornie Bayou	Lillie, La.	USGS	73662	91.48	208	1956-68	164	504	52	21,400	0	108.0	92.3
Ouachita River	Monroe, La.	USCE	73670	31.40	15,298	1953-69	15,453	34,890	5,822	97,200	500	81.9	44.1
Castor Creek	Grayson, La.	USGS	73705	89.89	271	1941-68	249	521	23	21,200	0	106.1	DRY
Garrett Creek	Jonesboro, La.	USGS	73710	171.86	2	1953-69	2	6	0	1,670	0	181.7	--
Dugdemona River	Winnfield, La.	USGS	73720	81.14	654	1940-68	715	1,774	63	27,100	0	104.9	82.0
Little River	Rochelle, La.	USGS	73722	24.79	1,880	1958-68	1,832	4,456	262	51,900	14	75.7	30.6
Bayou Funny Louis	Trout, La.	USGS	73725	81.51	92	1939-68	127	268	30	32,700	0	104.8	DRY
Big Creek	Pollock, La.	USGS	73730	76.69	51	1942-68	62	126	23	23,500	4	94.9	77.7
Red River	Alexandria, La.	USCE	73555	44.26	67,500	1929-70	31,020	61,830	11,050	233,000	873	89.5	41.25

1/ This period of record applies to annual flows and not necessarily to momentary flows or stage data; however, the momentary flows and stage data occurred under conditions similar to that which existed during the period of record indicated.

showing the mean annual runoff for WRPA 5 is shown in figure 209.

Average discharge for selected stations. In this section of the report, detailed data are presented for each of the selected gaging stations of WRPA 5 listed in table 126. Shown in tables 127-160 are observed mean discharges by months for each of the selected sites. These tables also present the average monthly and average annual flows for the period of record at each station. These flows reflect regulation and water use under 1973 levels of development.

Peak flow frequency curves at selected sites are shown in figures 211-240. These curves are a reflection of the annual peak discharge at the stations and were computed using the log-Pearson Type III procedure [6]. Due to regulation of peak flows, no frequency curves were computed for stations at the major reservoir sites. No frequency curves were computed for the station at Hurricane Creek near Sheridan, Ark., because the period of record was too short to develop a frequency curve that would represent a long-term trend.

Low flow frequency curves for most of the selected sites are shown in figures 241-263. These curves represent the annual lowest average flow for periods of 7, 30, 60, and 90 consecutive days. Due to regulation immediately upstream, short periods of record, or the frequent occurrence of zero flows, no low flow frequency curves were computed for ten of the selected sites. Along the main stem of the Ouachita, a series of dams, whose purpose is to maintain a year-round navigable depth on the river from Camden, Ark., to the mouth creates a condition which prevents accurate low flow measurements from being obtained. Hence, no low flow curves were computed for stations on the Ouachita River at Monroe, La., and near the Arkansas-Louisiana State line.

Duration curves for daily flows at the selected sites in WRPA 5 are presented in figures 264-296. These curves show the percent of time that specified discharges were equaled or exceeded at the sites during given periods. The curves indicate flow characteristics of the streams throughout their entire range of discharges without regard to the sequence of occurrences. The maximum daily flows are listed on the curves because of the lack of space required to extend the curves to the zero percent exceedence point.

The slope of the duration curve is a quantitative measure of the variability of the discharge in a particular stream. A flat slope on the lower end depicts a well sustained flow or a stream with a relatively high yield. The overall slopes of the curves for streams having large low flow yields are usually flatter than those for streams having small low flow yields. The duration curves can also reflect characteristics of regulation in a stream. Regulation can be detected on the duration curves by the flattening of the curves in the middle (30-70 percent) exceedence ranges. The reservoirs cause this change in flow

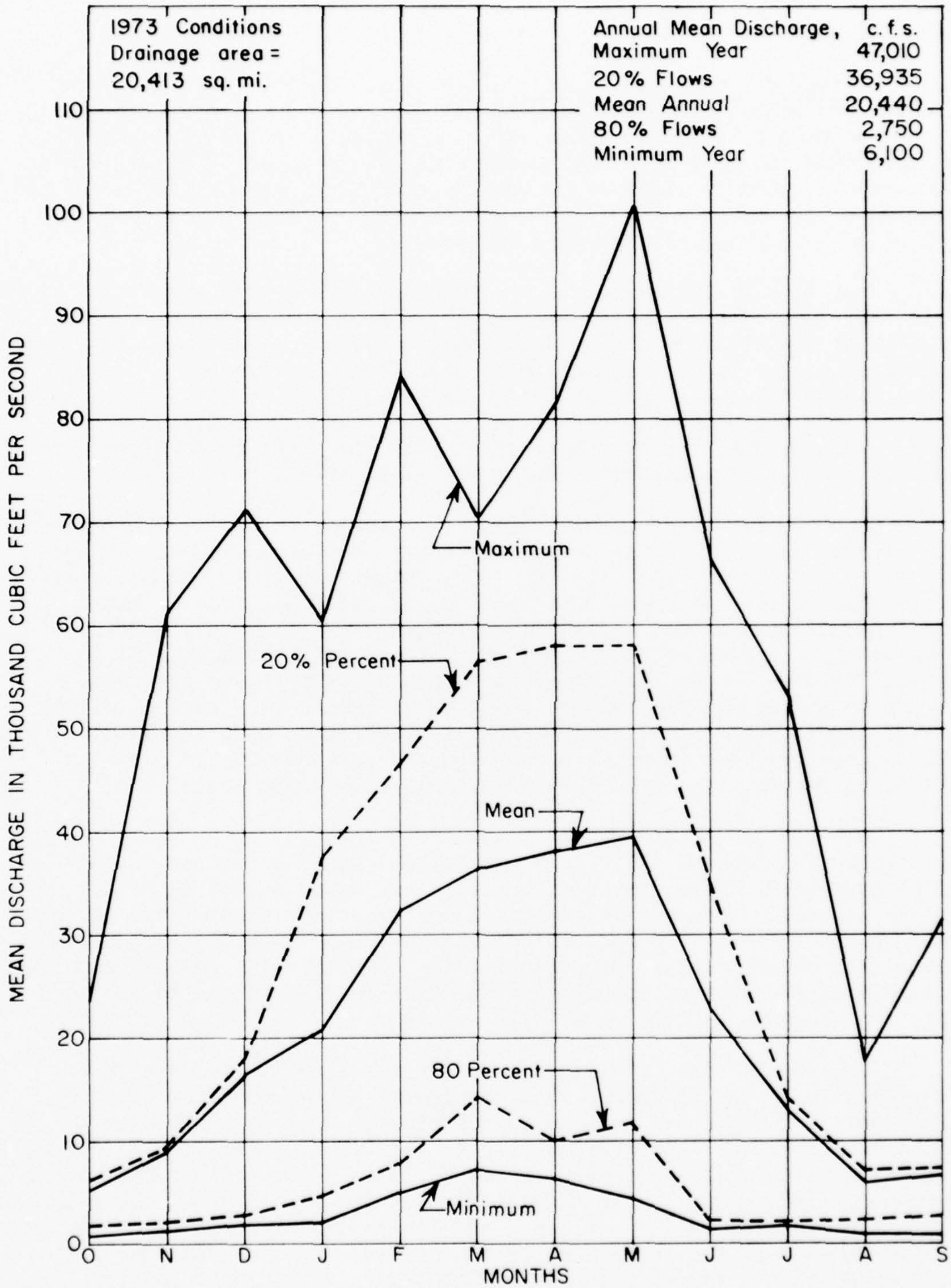


Figure 210 Monthly discharge from WRPA 5
Note: Does not include inflow from the Red River.

characteristics by lessening the peak flows and by supplementing low flows at the site for a large percentage of the time. This can be detected on the curves below the reservoirs in figures 266 and 270.

Tables 161-190 present data on the dependable yield characteristics at each of the selected discharge sites. These tables show the lowest mean flows for from 1 to 10 consecutive years of the period of record. The relationship of these lowest mean flows to the period of record mean is also given.

The minimum yearly flow for the stations in WRPA 5 ranged between 9 and 55 percent and averaged 30 percent of the mean annual flow. During the 10 consecutive years of lowest mean flow, the dependable yield averaged about 84 percent of the mean annual flow for the WRPA.

Variations in precipitation and discharge. Long-term variations in precipitation and discharge for the Ouachita River at Camden and Arkadelphia, Ark., are shown in figures 297 and 298, respectively. The annual means for the period of record are also shown. Although the annual precipitation at Camden varied from the mean by as much as 54 percent, the 5-year moving average varied from the mean by no more than 20 percent. Hence, the mean and 5-year moving averages of both precipitation and discharge at each site are presented to illustrate the general trend of the relationship between the precipitation and discharge.

Seasonal variations in runoff and streamflow were reflected in the hydrograph of figure 210. The major peak flows usually occur during the months of March to May. This is due to the large spring rains in the area. The months of low runoff are August, September, and October. Low streamflow during these months is generally attributed to the small amount of rainfall in the area at this time of year. The hydrograph discussed above can be used to define basins that receive large amounts of flow from surface or underground reservoirs, as they exhibit the smallest variations in monthly flows.

Flow Velocities

Time of travel studies have been made on the Caddo, Dugdemona, and Red Rivers in WRPA 5. Travel times were measured from dye tracings through subreaches of each stream during conditions of intermediate flow. There data were used to compute the average velocity of flow in each subreach, as shown in figure 52.

The velocities correspond to specific discharges, and since velocity is a function of discharge, this information may not be applicable to any other condition of flow. In general, stream velocities vary with discharge so that at higher discharges, greater velocities would be expected. The discharges shown in figure 50 for streams in WRPA 5 are for flows which are equaled or exceeded about 60 to 85 percent of the time.

Velocities shown in figure 52 represent the average velocity through a subreach; however, velocities can vary from point to point within the subreach. The velocities given for streams in WRPA 5 were determined from preliminary studies and may be subject to further revision.

River Profile

A profile of the Ouachita River is shown in figure 299. This profile was constructed from topographic maps and data from available reports [138]. The 50 percent duration flow line was plotted from data at various gaging stations along the river. The profile also shows the navigation locks and dams and their respective pool stages which are currently in operation. No profiles were derived for the other streams in the area.

Quality

The dissolved-solids content of water in the streams sampled in WRPA 5 (table 191) ranges from 12 to 3,090 mg/l, hardness from 6 to 940 mg/l, iron from 0 to 1.2 mg/l, fluoride from 0 to 2.0 mg/l, nitrate from 0 to 4.0 mg/l, and silica from 0 to 39 mg/l. The higher concentrations of dissolved solids and hardness are from streams that contain oil field wastes. Where water contains fluoride, the concentration is much higher than would normally be expected, and the source of the fluoride is not known.

For most industrial and municipal uses, surface water in the area requires some treatment, the degree and type of which depend on the quality and intended use of the water. In many of the unpolluted streams in this area, the water would be suitable for some uses, such as cooling, with little or no treatment. However, for municipal and most industrial uses the water would require, as a minimum treatment, pH adjustment for corrosion control and, for some water, color and iron removal. Much of the water also would require silica removal if it were to be used in high-pressure boilers. Because of the present and potential variations in the chemical quality of water in streams receiving oil field wastes, these streams generally are not suitable as sources of municipal or industrial water supplies [105]. The chemical characteristics of water in the streams sampled are listed in table 191.

The geologic units contributing water to Ozan Creek near McCaskill, Ark., are the Tokio Formation of Cretaceous age and the alluvium of Quaternary age. The water is a calcium bicarbonate type and the composition indicates that the principal soluble constituent in the aquifer materials is calcium carbonate. The variation in dissolved solids of the two analyses, 56 and 91 mg/l, probably is due to the relative amounts of water contributed from each formation. Water from Quaternary deposits generally has a higher calcium bicarbonate content than water

from the outcrop of the Tokio Formation. Thus, the increase in calcium bicarbonate with the decrease in discharge (from 0.27 to 0.14 c.f.s.) is indicative of a larger percentage of the flow coming from the Quaternary deposits. The water in Ozan Creek near McCaskill, Ark., is similar in chemical characteristics to water in the Little Missouri River near Boughton, Ark. (U. S. Geol. Survey, 1959b, p. 227-229), and its quality is representative of the quality of water in other streams draining areas of similar geology.

Walnut Bayou near Foreman, Ark., drains the Ozan Formation and alluvium. The water in this stream generally is high in dissolved solids, and the large amounts of sulfate and chloride indicate that most of the water is from the Ozan Formation.

Low flow water in the streams that drain Eocene Formations, or various combinations of Eocene and Quaternary Formations, is variable in dissolved-solids content and in chemical characteristics. Water in these streams is slightly acid, and where the activities of man have not affected the water quality, the water is generally soft (0-60 mg/l hardness) but has a dissolved-solids content of as much as 100 mg/l. In many of the streams, a large part of the variation in dissolved solids is caused by the variation in the silica content. Such water does not seem to have any chemical characteristic peculiar to one formation or a combination of formations. Calcium, sodium, and sulfate are the predominant constituents in water from Francois Creek. Water in Kelly Creek near Marietta, Tex., resembles the chemical characteristics of water from Francois Creek near Poyen, Ark., in that sulfate is the predominant anion. Kelly Creek drains the Carrizo Sand and the Reklaw and the Queen City Sand Members of the Mount Selman Formation.

Except where oil field wastes are present, water in streams draining alluvium and terrace deposits generally is a calcium-magnesium bicarbonate type. The dissolved-solids content of water in streams draining terrace deposits or a combination of terrace deposits and alluvium generally is higher than that of water in streams draining only the alluvium.

The chemical quality of water in Caney Creek near Bluff City, Ark., is affected by the addition of oil field wastes, and the dissolved-solids content of water is 1,740 mg/l. Sodium and chloride are the principal constituents, but when the dissolved solids are low, the chemical characteristics are variable. Because of numerous active oil fields in southern Arkansas, many streams other than those listed may contain wastes, but it is beyond the scope of this study to determine the degree of contamination of streams in the area.

Table 127 - Observed Mean Discharge in c.f.s., Sta 73560.00, Ouachita River near Mount Ida, Ark., 1942-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1942	839	1,010	751	709	786	1,465	2,405	907	490	151	369	1,246	927
1943	64	488	636	270	170	719	743	892	371	59	14	13	369
1944	59	191	522	754	2,081	2,106	1,668	1,758	490	53	51	59	815
1945	22	88	1,694	593	4,574	5,692	1,055	1,317	1,938	148	162	940	1,518
1946	960	374	348	2,173	2,084	1,422	1,230	3,193	604	129	49	31	1,049
1947	39	1,271	1,486	446	158	522	683	1,180	74	24	158	456	541
1948	74	676	1,603	1,700	1,883	1,323	523	838	87	179	149	28	755
1949	28	294	830	3,676	1,369	1,568	669	1,396	1,134	98	37	38	928
1950	323	110	1,046	3,419	3,093	586	339	1,784	545	884	506	1,392	1,168
1951	224	144	90	787	1,978	684	493	409	533	1,130	45	123	553
1952	222	1,307	812	1,125	879	1,593	4,072	420	106	37	34	44	887
1953	26	1,138	912	871	940	1,438	1,783	1,965	59	800	101	28	838
1954	24	51	106	870	689	199	476	1,427	48	14	6	5	326
1955	878	209	398	402	917	1,198	789	630	164	89	57	29	480
1956	63	34	47	249	2,383	415	322	509	44	58	16	12	345
1957	7	65	308	1,222	1,030	1,393	4,230	1,760	1,201	64	128	262	972
1958	115	1,103	417	643	295	1,696	1,529	2,054	597	381	66	63	746
1959	309	1,836	317	371	879	1,492	981	275	113	285	98	38	582
1960	194	182	1,509	1,198	731	736	280	3,329	574	965	131	41	822
1961	64	210	2,085	746	1,175	2,299	815	827	482	291	95	284	781
1962	322	937	1,233	1,029	1,251	903	645	241	100	30	18	101	567
1963	354	261	198	180	104	1,351	275	253	79	25	27	23	260
1964	10	22	37	34	171	1,868	1,421	218	34	21	218	320	364
1965	112	509	274	748	1,350	918	451	764	612	89	15	312	512
1966	72	48	85	528	1,358	294	1,963	1,075	51	36	90	34	469
1967	25	39	136	152	188	787	958	1,750	489	410	48	44	418
1968	205	333	1,332	891	806	2,610	2,473	3,373	362	115	99	35	1,052
1969	44	897	1,737	1,858	1,651	907	406	1,064	583	908	101	34	849
1970	100	643	1,019	606	811	1,564	2,106	395	166	46	24	54	627
Mean	199	498	757	974	1,233	1,370	1,233	1,241	418	259	100	209	708

Table 128 - Observed Mean Discharge in c.f.s., Sta 73565.00, South Fork Ouachita River at Mount Ida, Ark., 1949-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1949	--	--	--	--	--	--	--	--	--	28	17	7	--
1950	45	14	147	480	410	100	36	166	42	28	28	214	146
1951	26	21	14	119	315	93	102	32	43	131	6	63	80
1952	73	207	110	203	116	363	535	67	13	7	7	10	142
1953	6	205	153	176	147	222	256	284	9	107	9	5	131
1954	5	10	14	63	54	20	40	178	6	2	0	2	32
1955	105	27	94	55	114	155	82	99	14	37	11	31	68
1956	53	9	12	117	386	62	54	55	6	3	3	2	63
1957	1	13	32	224	139	221	426	333	112	11	18	35	130
1958	40	258	60	104	41	218	195	292	68	26	9	8	109
1959	36	170	41	40	172	218	88	27	28	72	16	11	76
1960	26	29	233	141	87	109	39	390	61	71	9	7	100
1961	11	59	231	95	199	341	117	213	41	19	12	44	115
1962	12	102	119	164	210	173	110	53	13	5	6	41	83
1963	88	36	29	25	26	187	39	24	26	5	2	6	40
1964	2	7	8	5	28	338	232	25	5	3	67	18	61
1965	6	36	30	105	205	132	51	93	47	7	4	94	67
1966	10	10	17	85	158	27	297	87	4	3	51	5	62
1967	5	9	32	28	32	93	126	299	39	23	7	10	58
1968	17	35	123	87	61	384	235	683	117	17	11	9	148
1969	9	100	235	326	247	135	41	65	72	217	15	5	122
1970	19	108	168	72	121	252	283	48	33	6	7	6	93
Mean	28	69	90	129	155	183	161	167	38	37	14	28	92

Table 129 - Observed Mean Discharge in c.f.s., Sta 73575.01, Ouachita River at Blakely Mountain Dam near Hot Springs, Ark., 1953-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1953	60	364	2,123	923	107	126	192	4,175	547	682	624	470	866
1954	584	501	478	199	340	469	351	84	478	490	539	621	427
1955	235	450	260	246	120	188	69	221	371	444	655	405	305
1956	1,593	1,238	439	142	1,538	1,596	761	90	224	415	492	1,253	814
1957	1,536	1,344	296	814	1,822	846	5,158	7,029	6,687	1,147	1,685	997	2,446
1958	1,776	1,357	2,345	2,473	1,649	85	717	5,640	862	2,049	2,025	2,365	1,945
1959	1,852	1,683	2,743	1,605	1,438	1,445	1,622	533	520	537	1,692	1,732	1,450
1960	1,296	753	795	1,990	2,456	1,787	429	2,326	2,260	1,805	2,249	2,027	1,680
1961	2,071	1,286	1,992	2,459	942	1,284	3,418	2,024	801	1,412	2,052	2,062	1,816
1962	2,168	1,406	1,925	2,062	2,157	2,337	2,084	408	153	248	1,319	1,220	1,457
1963	2,168	2,278	607	908	343	107	389	284	210	95	299	269	663
1964	857	617	963	284	85	168	1,499	1,022	446	646	1,366	2,172	843
1965	2,257	979	1,020	621	1,144	1,475	218	308	404	1,829	2,626	2,257	1,261
1966	979	411	573	667	215	590	364	2,870	1,552	2,064	1,530	1,883	1,141
1967	1,204	873	457	245	168	222	112	342	952	2,102	2,254	942	822
1968	1,235	1,352	2,034	2,212	1,020	1,095	4,867	4,999	7,304	1,595	1,400	1,910	2,585
1969	1,925	494	1,935	3,664	5,003	1,371	238	477	411	2,270	2,435	1,655	1,823
1970	862	880	1,219	3,285	1,943	1,846	2,031	1,793	719	630	544	564	1,359
Mean	1,369	1,014	1,233	1,377	1,249	946	1,362	1,923	1,383	1,136	1,432	1,378	1,317

Table 130 - Observed Mean Discharge in c.f.s., Sta 73595.00, Ouachita River near Malvern, Ark., 1954-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1954	517	517	658	1,184	838	572	605	2,359	449	415	371	441	743
1955	834	762	997	782	1,237	2,388	625	1,027	450	491	592	651	903
1956	2,222	1,262	633	287	5,904	2,138	1,477	865	270	449	480	1,265	1,437
1957	1,933	1,675	431	1,832	3,331	2,342	10,328	10,240	7,128	1,293	1,973	2,278	3,732
1958	2,359	2,869	3,337	3,822	1,945	1,454	2,405	8,911	1,059	2,297	2,123	2,761	2,945
1959	2,436	2,714	3,135	2,308	3,680	2,529	2,283	622	748	686	1,746	1,882	2,064
1960	1,436	1,450	3,044	3,729	3,543	3,141	590	3,479	2,512	1,895	2,169	2,448	2,452
1961	2,215	2,197	3,693	3,149	2,058	3,937	4,848	2,960	1,068	1,492	2,140	2,147	2,658
1962	2,158	2,466	3,441	4,103	4,030	3,743	2,653	628	335	290	1,255	2,105	2,267
1963	2,674	3,098	867	1,121	611	1,445	403	360	257	1,491	325	267	1,076
1964	833	1,668	1,314	389	723	1,961	5,204	1,062	448	639	1,382	2,278	1,491
1965	2,232	1,575	1,682	1,786	2,864	1,820	460	429	611	1,815	2,544	2,470	1,690
1966	932	815	767	1,037	1,349	442	3,014	3,346	1,425	2,096	2,850	1,942	1,667
1967	2,157	550	1,110	601	501	572	755	3,026	1,169	3,602	2,254	1,015	1,442
1968	1,304	1,937	3,303	2,989	1,532	2,535	5,855	10,289	7,086	1,652	1,536	1,937	3,496
1969	2,042	1,368	3,612	6,681	6,314	1,993	710	858	913	2,638	2,449	1,666	2,603
Mean	1,767	1,682	2,001	2,237	2,528	2,063	2,638	3,153	1,620	1,452	1,636	1,722	2,042

Table 131 - Observed Mean Discharge in c.f.s., Sta 73598.00, Caddo River near Alpine, Ark., 1939-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1939	70	229	184	600	1,740	643	2,193	162	86	58	69	22	504
1940	34	51	69	81	254	92	959	804	428	193	52	46	255
1941	24	1,232	474	302	708	370	644	577	450	194	44	375	449
1942	--	--	--	--	--	--	--	--	--	--	--	--	--
1943	--	--	--	--	--	--	--	--	--	--	--	--	--
1944	--	--	--	--	--	--	--	--	--	--	--	--	--
1945	--	--	--	--	--	--	--	--	--	--	--	--	--
1946	--	--	--	--	--	--	--	--	--	--	--	--	--
1947	90	1,360	1,153	396	178	517	594	683	76	46	29	79	433
1948	100	613	940	670	1,572	1,475	520	287	65	62	53	29	532
1949	37	212	475	3,034	831	1,560	388	683	584	132	63	52	670
1950	518	127	898	2,247	2,436	867	224	1,473	273	169	105	694	835
1951	142	143	88	815	1,518	398	703	338	255	827	60	307	466
1952	124	773	706	1,032	746	949	2,772	255	86	53	44	44	632
1953	35	803	1,868	872	901	1,140	1,648	2,264	65	793	66	79	877
1954	40	64	105	496	208	110	248	978	66	21	10	20	197
1955	847	236	536	593	644	1,604	405	828	141	161	53	128	497
1956	142	71	101	433	2,412	212	413	624	42	30	20	23	376
1957	23	84	90	789	842	976	2,629	2,092	656	77	208	182	720
1958	373	1,449	706	730	210	1,156	1,324	2,440	250	244	65	91	753
1959	154	765	183	213	1,542	972	434	124	157	121	59	59	398
1960	102	126	1,529	986	552	723	166	915	314	149	50	61	472
1961	81	257	1,435	440	972	1,884	740	1,719	119	90	126	286	678
1962	83	670	861	1,231	1,388	948	580	352	106	52	36	228	544
1963	535	235	188	198	199	1,181	277	144	61	56	45	50	263
1964	26	99	83	57	245	1,425	2,036	176	48	34	176	124	377
1965	70	91	206	473	1,421	597	258	176	228	113	36	166	319
1966	48	62	77	390	754	160	1,563	562	38	35	739	76	375
1967	71	84	337	203	189	601	815	2,169	284	153	50	59	417
1968	60	153	821	540	473	1,517	1,009	3,905	347	92	107	62	757
1969	52	352	1,079	1,763	1,059	630	271	245	601	301	78	34	538
1970	51	483	754	366	606	1,168	1,336	209	250	40	54	46	446
Mean	145	400	590	731	911	884	931	932	225	159	92	126	510

Table 132 - Observed Mean Discharge in c.f.s., Sta 73600.00, Ouachita River at Arkadelphia, Ark., 1954-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1954	489	537	748	2,360	1,681	802	1,114	4,417	474	347	286	343	1,133
1955	1,792	1,054	1,830	1,580	2,697	5,736	1,713	2,382	694	626	502	936	1,795
1956	2,270	1,353	799	550	10,456	2,577	2,551	2,355	282	368	369	1,061	2,082
1957	1,802	1,721	516	2,472	4,841	3,909	15,448	13,505	7,932	1,266	1,893	2,117	4,785
1958	2,953	6,267	4,345	4,929	2,405	3,398	4,816	15,328	1,575	2,755	2,396	2,870	4,503
1959	2,650	3,730	3,467	2,841	6,669	4,467	3,722	1,020	1,436	990	1,872	2,028	2,907
1960	1,729	1,762	5,805	5,717	4,820	4,775	1,016	4,652	3,575	2,302	2,207	2,656	3,418
1961	2,577	2,892	5,772	4,046	4,271	7,639	7,321	5,319	1,350	1,653	2,354	2,559	3,979
1962	2,348	3,561	5,703	7,051	7,053	5,706	3,850	1,366	656	340	1,187	3,332	3,512
1963	4,106	3,519	1,532	1,675	1,148	4,243	1,222	771	353	1,574	390	282	1,734
1964	727	2,356	1,923	530	1,566	4,871	10,139	1,713	600	766	1,633	2,595	2,451
1965	2,600	1,851	2,472	3,682	6,410	3,685	1,201	728	876	2,134	2,775	2,587	2,583
1966	1,072	1,225	1,059	1,780	3,083	1,015	7,428	5,040	1,913	2,609	6,034	2,146	2,867
1967	2,718	1,018	2,212	1,485	1,183	2,012	2,236	6,991	2,130	5,411	2,788	1,197	2,615
1968	1,465	1,912	4,586	4,368	2,984	5,796	8,277	21,015	7,565	1,936	1,757	2,447	5,342
1969	2,193	2,038	5,256	10,387	9,503	3,881	1,512	1,518	2,154	2,834	2,531	1,533	3,778
1970	949	1,545	2,918	4,431	3,757	4,737	4,910	4,860	2,134	654	597	635	2,677
Mean	2,025	2,255	2,996	3,522	4,383	4,073	4,616	5,469	2,099	1,680	1,857	1,842	3,068

Table 133 - Observed Mean Discharge in c.f.s., Sta 73605.01, Little Missouri River at Narrows Dam near Murfreesboro, Ark., 1950-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1950	--	--	--	1,109	7	4	3	102	327	224	227	584	--
1951	353	239	234	232	877	399	473	235	234	729	488	331	617
1952	113	215	287	438	429	693	1,613	587	326	166	372	327	463
1953	69	63	460	506	759	686	1,024	1,838	617	503	713	598	652
1954	121	54	66	14	67	44	11	53	304	343	462	121	138
1955	61	356	215	194	273	654	765	249	416	511	644	501	403
1956	128	196	45	51	246	149	81	349	234	399	506	265	220
1957	73	89	24	63	159	401	1,101	1,969	1,311	442	401	521	546
1958	502	953	1,118	186	157	119	413	1,856	383	579	489	353	592
1959	159	196	367	188	107	481	278	114	279	403	403	380	279
1960	218	153	542	797	370	358	158	192	268	482	639	559	394
1961	51	73	421	226	188	733	1,093	1,226	307	577	707	405	500
1962	236	253	248	715	676	803	666	291	157	455	496	252	437
1963	336	343	207	216	16	91	133	58	63	423	451	178	209
1964	193	18	90	13	10	18	268	684	309	450	373	247	222
1965	159	200	173	226	318	295	198	172	272	472	462	233	264
1966	155	192	46	45	89	53	120	492	268	427	481	326	224
1967	151	152	164	172	42	15	22	1,547	302	158	214	83	251
1968	57	409	614	301	395	626	836	1,620	2,112	538	647	139	691
1969	308	275	218	365	1,875	872	189	445	433	454	423	341	516
1970	358	187	187	715	264	447	591	704	155	169	167	410	362
Mean	190	230	286	322	348	378	477	703	437	424	465	340	399

Table 134 - Observed Mean Discharge in c.f.s., Sta 73610.00, Little Missouri River near Murfreesboro, Ark., 1952-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1952	140	295	442	750	625	922	2,648	665	335	178	400	352	646
1953	79	205	1,013	907	1,066	1,085	1,811	3,119	651	650	754	632	997
1954	139	56	72	113	109	59	188	373	320	375	496	139	203
1955	441	449	415	347	533	1,281	1,191	476	467	560	656	556	614
1956	154	185	64	72	938	236	275	681	235	416	534	284	339
1957	65	86	26	130	353	927	2,150	2,590	1,438	447	480	655	778
1958	812	1,728	1,414	545	233	537	924	3,256	557	662	517	502	973
1959	196	375	437	231	610	811	491	164	448	449	435	434	423
1960	338	198	1,103	1,351	649	659	202	311	483	523	667	601	590
1961	63	69	778	349	470	1,557	1,443	1,577	308	742	814	511	723
1962	255	430	674	1,357	1,342	1,132	836	361	199	435	481	429	660
1963	426	478	274	303	56	582	209	92	66	392	457	161	291
1964	179	34	98	15	61	280	1,443	780	294	435	393	284	358
1965	159	184	197	344	785	614	282	235	333	465	432	223	354
1966	139	181	45	44	185	76	693	737	232	407	759	345	320
1967	187	157	313	232	97	113	482	2,449	381	181	223	78	407
1968	49	390	693	463	537	1,069	1,508	3,272	2,172	539	654	137	956
1969	342	435	652	1,358	2,406	1,212	327	796	579	511	463	395	789
Mean	231	329	483	495	614	730	950	1,218	527	464	534	373	579

Table 135 - Observed Mean Discharge in c.f.s., Sta 73612.00, Ozan Creek near McCaskill, Ark., 1962-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1962	76	290	601	814	867	375	191	40	323	8	1	30	301
1963	54	87	43	78	33	422	160	26	15	2	1	3	76
1964	0	6	31	11	77	226	938	34	3	0	2	20	112
1965	4	32	110	157	664	198	52	120	76	15	1	1	119
1966	1	0	0	5	102	30	929	545	2	0	112	20	145
1967	46	35	272	83	57	88	625	601	133	46	2	1	165
1968	2	4	131	426	256	548	450	1,715	322	48	11	26	328
1969	46	190	336	571	573	267	72	441	196	4	1	0	224
Mean	28	80	190	268	328	269	427	440	133	15	16	12	184

Table 136 - Observed Mean Discharge in c.f.s., Sta 73615.00, Antoine River at Antoine, Ark., 1955-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1955	249	113	243	221	428	829	334	366	82	46	3	11	243
1956	31	5	18	41	971	116	337	371	5	1	0	0	157
1957	0	0	3	98	358	536	1,438	1,024	289	18	9	31	317
1958	141	787	340	478	105	526	707	1,943	123	264	9	241	471
1959	68	355	111	89	684	377	270	25	122	12	3	4	176
1960	15	29	656	697	388	463	56	135	174	37	2	9	221
1961	24	87	604	251	487	1,096	517	435	27	87	16	15	303
1962	47	221	520	774	807	479	241	87	29	4	2	97	275
1963	219	165	109	118	76	623	187	67	9	20	4	4	133
1964	0	73	82	27	162	506	1,280	96	5	1	4	29	188
1965	8	19	145	178	643	486	150	43	124	19	3	4	151
1966	1	0	1	21	206	75	810	305	3	3	598	24	170
1967	36	31	231	115	108	200	467	1,124	90	24	6	6	203
1968	3	24	246	331	253	612	467	2,266	107	25	13	7	362
1969	13	134	430	925	595	410	214	216	285	54	5	0	273
Mean	57	136	249	290	418	488	498	566	98	41	45	32	243

Table 137 - Observed Mean Discharge in c.f.s., Sta 73616.00, Little Missouri River near Boughton, Ark., 1952-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1952	164	534	1,002	2,124	1,691	1,800	5,845	1,495	414	165	428	334	1,333
1953	83	497	2,288	2,289	2,854	3,154	4,702	9,963	925	1,186	717	480	2,426
1954	185	73	118	1,011	636	209	856	1,804	324	334	387	170	509
1955	913	701	1,150	1,041	2,182	3,732	2,956	1,624	786	743	609	549	1,415
1956	244	199	142	153	3,708	679	552	2,438	251	379	490	328	797
1957	67	96	51	253	1,417	2,476	7,679	6,181	2,980	463	467	645	1,897
1958	1,287	4,806	2,408	2,332	598	2,122	3,470	9,020	1,217	1,022	534	908	2,477
1959	324	1,330	726	484	2,952	1,905	1,428	272	1,967	566	417	493	1,072
1960	385	302	3,502	4,011	2,431	2,683	450	566	727	577	539	485	1,388
1961	148	220	1,948	1,040	2,348	4,892	4,089	2,309	396	1,058	808	609	1,655
1962	485	1,200	2,789	4,484	4,672	3,298	1,719	704	703	431	433	654	1,797
1963	881	852	551	593	246	2,521	748	384	102	327	380	186	647
1964	211	207	298	89	424	1,577	5,921	1,098	269	383	387	360	935
1965	191	263	647	940	3,729	1,856	741	526	529	278	255	163	843
1966	120	165	57	88	567	241	3,273	3,406	213	392	1,462	419	866
1967	263	217	911	654	377	579	2,170	4,798	1,005	312	202	99	965
1968	54	376	1,211	1,575	1,695	3,135	3,303	10,696	3,015	719	670	186	2,219
1969	369	828	1,835	2,804	5,756	2,568	948	1,845	1,515	530	397	323	1,643
1970	319	234	1,077	1,522	1,627	3,609	3,315	1,530	1,389	158	174	371	1,277
Mean	352	689	1,195	1,446	2,099	2,265	2,850	3,192	985	527	513	408	1,377

Table 138 - Observed Mean Discharge in c.f.s., Sta 73620.00, Ouachita River at Camden, Ark., 1953-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1953	349	2,008	10,273	9,378	11,089	13,787	14,463	45,757	3,016	3,254	1,775	1,206	9,696
1954	878	709	1,099	4,790	3,976	1,742	2,662	9,060	1,203	1,008	896	666	2,390
1955	2,491	2,147	2,826	3,697	6,955	13,687	9,284	4,230	2,964	1,742	1,295	1,481	4,399
1956	2,620	1,591	1,263	839	19,141	4,719	3,775	7,209	1,143	920	924	1,377	3,793
1957	1,672	1,747	885	2,593	12,633	9,140	32,550	32,974	16,835	2,185	2,817	3,275	9,942
1958	5,947	18,965	10,169	11,767	4,681	8,678	11,182	49,997	3,834	4,565	3,279	4,840	11,492
1959	3,390	5,939	5,343	4,705	14,970	9,141	7,453	1,945	8,122	1,974	2,532	2,713	5,685
1960	2,521	2,446	13,633	16,140	12,223	13,773	2,735	6,046	4,197	3,921	2,933	3,273	6,986
1961	3,079	3,221	9,556	7,231	10,230	13,445	24,541	9,793	2,223	4,590	3,479	3,689	7,922
1962	3,675	6,526	15,297	19,558	16,565	20,339	8,881	3,654	2,592	1,111	1,534	4,850	8,715
1963	6,390	5,394	3,090	3,232	2,330	10,680	2,658	2,970	668	2,191	804	629	3,419
1964	794	2,901	2,908	1,070	2,940	10,304	20,693	7,528	1,051	991	2,130	3,128	4,703
1965	2,684	2,079	3,735	6,860	17,654	9,095	5,012	2,174	2,406	2,451	3,116	3,130	5,033
1966	1,421	1,196	1,344	1,997	5,221	1,986	14,712	22,212	2,063	3,373	7,469	2,959	5,496
1967	3,008	1,447	2,725	3,989	2,234	3,835	6,007	19,432	4,243	4,291	3,098	1,650	4,663
1968	1,480	2,645	7,344	9,905	7,874	15,638	13,540	52,199	12,940	3,273	3,397	2,564	11,066
1969	2,603	2,891	8,717	8,727	32,850	10,794	5,007	4,431	5,577	3,888	3,575	2,162	7,601
1970	1,550	2,691	4,014	11,056	8,530	16,491	12,882	11,797	5,388	1,161	961	1,235	6,479
Mean	2,586	3,696	5,790	7,085	10,672	10,404	11,002	16,300	4,470	2,604	2,556	2,490	6,638

Table 139 - Observed Mean Discharge in c.f.s., Sta 73621.00, Smackover Creek near Smackover, Ark., 1962-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1962	312	876	1,695	1,980	775	758	749	487	542	61	17	83	694
1963	100	71	81	109	106	301	197	97	16	25	5	23	94
1964	2	14	100	58	80	289	869	154	11	2	5	64	137
1965	15	35	455	552	1,442	793	373	286	61	15	12	83	343
1966	11	22	53	94	614	165	1,178	1,701	17	8	40	19	326
1967	20	12	76	93	100	112	159	326	204	43	4	11	96
1968	4	11	110	867	448	813	751	1,688	161	77	40	145	426
1969	52	70	474	158	1,497	1,389	666	218	60	7	2	2	382
1970	4	253	235	533	611	1,313	1,015	649	91	9	19	5	394
Mean	57	151	364	493	630	659	661	622	129	27	16	48	321

Table 140 - Observed Mean Discharge in c.f.s., Sta 73630.00, Saline River at Benton, Ark., 1951-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1951	178	284	282	1,458	2,227	450	1,159	608	318	888	84	82	668
1952	50	993	1,105	1,411	1,396	1,444	2,959	521	86	26	36	48	839
1953	22	918	1,941	1,538	1,411	2,166	2,325	3,041	84	136	27	16	1,135
1954	19	49	92	1,003	621	215	413	2,530	33	3	4	1	415
1955	115	88	406	295	973	1,563	357	1,365	230	146	53	56	470
1956	240	72	139	1,297	4,935	481	715	797	53	102	15	8	737
1957	16	109	160	1,619	1,615	1,245	4,444	3,124	1,134	107	930	104	1,217
1958	336	2,086	864	1,230	294	1,645	1,851	3,058	966	205	95	389	1,085
1959	123	865	317	634	2,800	1,206	607	[illegible]	1,273	289	67	248	711
1960	192	240	2,529	1,651	1,039	1,287	228	1,685	311	108	38	86	782
1961	126	330	944	491	934	2,539	1,610	858	290	114	129	67	702
1962	59	580	1,332	1,777	2,413	1,619	756	273	140	73	26	339	782
1963	279	151	174	195	242	1,430	375	146	57	258	38	16	280
1964	27	470	169	81	578	2,432	3,120	240	35	16	21	112	608
1965	53	217	444	1,330	1,791	846	368	290	134	47	27	656	516
1966	72	50	72	708	1,312	341	2,818	1,109	47	26	951	76	631
1967	39	72	392	367	422	845	689	2,119	374	823	187	433	563
1968	183	406	1,533	816	700	1,790	1,213	5,376	231	168	171	132	1,059
1969	186	477	1,603	3,512	1,209	1,016	462	327	198	105	52	22	764
Mean	121	445	763	1,127	1,416	1,292	1,393	1,451	315	191	155	152	735

Table 141 - Observed Mean Discharge in c.f.s., Sta 73633.00, Hurricane Creek near Sheridan, Ark., 1962-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1962	4	52	482	890	953	636	350	298	44	8	4	18	311
1963	25	12	17	36	33	226	119	36	6	7	3	2	43
1964	1	11	15	9	34	418	1,425	80	9	2	4	19	168
1965	4	10	70	169	688	567	154	48	18	11	6	29	147
1966	6	8	28	48	354	94	928	328	8	6	199	16	168
1967	23	31	199	195	121	318	190	806	120	81	16	93	182
1968	35	83	527	542	266	648	297	1,530	51	31	17	22	337
1969	51	67	334	531	710	336	340	125	36	13	9	6	213
Mean	18	34	209	302	394	405	475	406	36	19	32	25	196

Table 142 - Observed Mean Discharge in c.f.s., Sta 73635.00, Saline River near Rye, Ark., 1938-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1938	209	2,366	2,253	8,979	12,449	5,043	10,177	1,173	381	236	188	29	3,623
1939	15	560	449	2,853	16,058	6,530	11,341	2,106	2,653	549	93	44	3,604
1940	25	51	111	158	859	706	2,565	1,293	979	1,992	266	95	758
1941	40	720	2,712	1,773	3,508	4,107	4,298	3,068	538	306	119	72	1,771
1942	424	690	1,347	1,952	2,926	4,748	10,315	6,202	767	188	197	181	2,494
1943	50	128	462	1,079	802	5,403	3,376	959	794	78	16	10	1,096
1944	28	52	140	440	2,114	5,393	7,814	9,491	332	40	116	154	2,176
1945	23	93	2,359	6,661	3,059	13,917	12,565	7,246	6,013	1,278	620	403	4,519
1946	2,148	4,285	3,164	14,832	9,792	5,091	7,992	8,224	3,287	267	144	54	4,939
1947	62	1,400	1,397	2,593	781	2,713	4,587	4,956	2,657	606	33	27	1,817
1948	61	757	1,401	2,205	7,930	11,830	4,826	2,354	240	211	183	51	2,670
1949	28	849	1,119	7,530	11,010	6,453	4,869	3,225	1,907	574	255	128	3,162
1950	2,730	1,448	3,312	14,430	16,713	6,727	4,093	6,614	687	178	633	4,511	5,173
1951	763	516	671	6,617	5,308	3,557	3,962	1,927	522	1,749	290	140	2,168
1952	91	669	3,002	4,221	4,950	6,237	7,351	2,063	388	69	71	87	2,433
1953	42	235	2,910	2,127	6,434	8,526	5,957	15,402	335	192	74	33	3,522
1954	24	56	146	1,479	1,821	855	1,035	4,703	147	32	11	5	859
1955	54	171	239	643	1,855	4,633	4,925	657	2,373	266	143	41	1,333
1956	305	100	211	143	11,063	2,781	2,280	2,849	200	180	48	26	1,682
1957	19	144	230	737	9,147	3,913	12,278	10,356	5,279	237	839	307	3,623
1958	1,236	9,690	5,058	4,550	2,420	4,058	5,460	21,469	1,322	1,069	907	1,875	4,926
1959	729	1,534	966	2,348	6,914	5,037	3,220	444	1,632	517	240	224	1,983
1960	433	366	4,260	6,114	4,398	6,937	910	2,507	925	3,141	126	81	2,516
1961	211	368	1,387	1,346	3,518	6,288	12,082	3,524	572	232	219	142	2,490
1962	102	801	6,262	6,102	5,408	9,743	3,962	2,002	636	126	101	495	2,978
1963	464	258	316	391	553	4,023	914	1,736	149	802	132	55	816
1964	25	254	446	230	924	5,144	8,350	4,935	113	66	42	147	1,723
1965	142	177	859	2,122	7,256	3,225	4,248	495	401	111	72	374	1,623
1966	275	90	131	733	3,816	1,121	2,228	10,527	160	52	1,098	478	1,725
1967	283	202	365	1,675	1,372	2,290	1,392	7,732	1,530	1,211	309	733	1,591
1968	248	700	3,197	4,725	3,025	6,026	4,560	18,141	1,392	381	305	142	3,570
1969	607	239	2,624	2,607	13,027	3,562	3,592	729	610	153	261	72	2,340
Mean	371	936	1,672	3,574	5,662	5,206	5,547	5,284	1,247	534	254	350	2,553

Table 143 - Observed Mean Discharge in c.f.s., Sta 73641.00, Ouachita River near Ark.-La. State Line, 1959-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1959	--	7,920	6,512	7,627	--	--	--	--	--	2,996	2,955	3,113	--
1960	3,201	2,828	--	--	--	--	--	8,913	4,657	7,035	2,874	2,557	--
1961	3,396	3,963	--	--	--	--	--	--	--	--	4,888	4,210	--
1962	3,941	--	--	--	--	--	--	--	5,462	1,485	1,831	5,252	--
1963	6,780	5,353	3,618	3,642	3,113	--	5,140	6,897	811	3,175	1,069	822	--
1964	914	2,690	3,876	1,904	4,183	--	--	--	--	1,264	1,545	3,178	--
1965	2,884	2,300	6,616	11,961	--	--	--	3,315	2,939	2,324	3,109	3,949	--
1966	1,669	1,186	1,514	2,709	--	--	--	--	--	2,559	7,119	3,935	--
1967	3,602	1,687	2,550	6,983	5,434	6,879	7,426	--	--	6,369	2,865	2,277	--
1968	1,650	3,084	10,746	--	--	--	--	--	--	--	3,498	4,008	--
1969	4,237	2,831	--	--	--	--	--	--	7,979	3,077	3,884	1,943	--
Mean	3,227	3,384	5,061	5,804	4,243	6,879	6,283	6,375	4,369	3,364	3,239	3,204	--

Table 144 - Observed Mean Discharge in c.f.s., Sta 73641.50, Bayou Bartholomew near McGehee, Ark., 1957-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1957	17	50	57	363	2,575	1,722	2,240	1,643	617	108	54	153	799
1958	319	2,240	1,912	1,128	843	808	923	5,972	1,429	496	228	1,300	1,466
1959	1,216	490	375	594	1,552	1,162	736	372	215	131	96	144	590
1960	160	100	415	875	1,065	1,857	490	335	191	129	34	100	479
1961	94	87	458	576	1,271	2,776	3,008	785	220	233	172	106	815
1962	93	390	2,445	1,943	1,351	1,163	849	345	414	100	36	130	771
1963	97	78	74	80	99	511	301	447	59	223	291	86	195
1964	34	39	324	398	220	908	1,319	1,828	50	28	23	48	434
1965	45	38	862	817	1,697	1,066	1,452	73	100	60	35	171	534
1966	141	22	41	39	1,724	664	83	2,210	97	24	39	56	428
1967	123	46	139	400	170	366	141	1,413	527	55	164	43	298
1968	17	14	339	1,594	1,027	1,340	1,851	2,246	1,207	119	107	213	839
1969	451	145	954	344	2,352	817	789	175	97	173	312	244	570
Mean	215	287	645	703	1,226	1,166	1,090	1,372	401	144	122	214	632

Table 145 - Observed Mean Discharge in c.f.s., Sta 73642.00, Bayou Bartholomew near Jones, La., 1958-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1958	426	2,856	4,636	2,781	2,245	1,897	1,839	5,337	4,463	1,871	485	1,653	2,540
1959	3,940	704	1,148	770	2,865	3,053	1,888	1,134	367	365	268	261	1,397
1960	240	200	320	1,154	1,723	3,185	1,749	700	408	206	159	169	850
1961	188	204	636	1,698	1,468	6,294	5,800	1,942	706	464	486	254	1,678
1962	260	924	4,078	5,073	3,811	2,264	1,721	1,095	631	316	143	185	1,708
1963	213	189	158	201	204	604	684	506	210	242	514	154	323
1964	104	82	313	816	461	1,944	2,203	3,500	362	67	65	78	832
1965	100	79	795	876	2,340	2,317	2,249	392	114	114	55	249	806
1966	245	70	72	104	2,402	2,322	184	1,997	731	45	55	78	692
1967	111	109	151	494	487	649	387	1,250	1,449	183	179	82	460
1968	61	41	210	2,820	2,454	1,743	3,979	2,683	3,174	214	215	401	1,499
1969	403	491	2,896	1,396	3,017	2,493	2,480	789	458	151	560	403	1,294
Mean	524	495	1,284	1,515	1,956	2,397	2,096	1,777	1,089	353	265	330	1,173

Table 146 - Observed Mean Discharge in c.f.s., Sta 73643.00, Chemin-A-Haut Bayou near Beekman, La., 1956-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1956	1	1	24	5	661	411	620	18	6	6	4	9	147
1957	1	30	28	191	672	430	820	420	607	100	8	48	279
1958	62	1,611	613	701	203	721	2,619	2,905	471	153	69	1,411	961
1959	190	25	14	116	835	544	315	13	64	82	23	40	188
1960	6	11	53	178	363	651	43	116	3	3	60	18	125
1961	5	15	120	280	1,399	1,030	838	33	44	108	48	26	328
1962	20	390	1,760	875	449	260	67	226	31	8	8	22	343
1963	8	5	5	11	17	94	34	40	9	22	20	11	22
1964	0	0	13	42	19	233	565	177	1	4	16	12	90
1965	8	3	60	69	456	248	290	1	21	23	26	100	108
1966	--	--	--	--	--	--	--	--	--	--	--	16	--
1967	10	1	34	40	363	49	69	249	529	55	34	16	121
1968	3	0	47	1,194	188	654	857	714	92	32	86	400	355
1969	29	454	1,014	44	475	467	369	176	88	41	23	25	266
Mean	26	195	291	288	469	445	577	391	151	49	32	153	256

Table 147 - Observed Mean Discharge in c.f.s., Sta 73647.00, Bayou De Loutre near Laran, La., 1956-1968

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1956	17	37	57	62	387	211	181	72	28	40	12	12	92
1957	11	55	46	173	379	164	649	345	139	24	14	50	170
1958	184	961	265	419	180	258	1,844	843	161	99	56	203	456
1959	37	156	88	118	373	332	334	70	501	142	29	89	188
1960	56	79	189	194	299	410	67	99	27	16	45	24	125
1961	32	78	382	310	431	472	314	61	87	812	88	51	259
1962	89	174	634	697	285	213	266	244	236	25	12	40	242
1963	74	55	80	76	113	118	118	108	33	76	30	44	76
1964	11	25	93	112	85	171	424	51	19	3	23	24	86
1965	14	26	75	132	322	225	205	30	16	8	19	59	94
1966	12	22	42	64	388	45	260	291	6	5	44	22	100
1967	33	25	62	66	159	98	102	196	150	26	5	11	77
1968	9	27	108	604	149	361	241	488	62	53	78	155	194
Mean	44	132	163	232	273	236	385	222	112	102	35	60	166

Table 148 - Observed Mean Discharge in c.f.s., Sta 73650.00, Bayou D'Arbonne near Dubach, La., 1941-1968

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1941	1	345	1,714	1,373	801	941	465	1,111	317	278	209	22	631
1942	23	469	242	272	253	529	1,313	1,106	280	50	77	55	389
1943	5	7	44	134	269	674	314	41	34	18	0	0	128
1944	1	9	32	463	2,043	1,628	872	1,467	116	3	19	59	559
1945	2	32	383	2,175	1,109	2,093	2,028	303	347	305	116	100	749
1946	474	233	354	2,540	2,165	1,144	631	1,428	859	230	141	39	853
1947	23	504	328	1,587	443	1,265	1,031	367	88	11	0	2	470
1948	2	57	339	473	1,581	797	500	107	9	4	0	0	322
1949	0	79	181	1,033	1,067	678	542	212	121	97	62	39	342
1950	1,104	226	611	2,087	1,449	902	458	1,004	657	143	84	952	806
1951	359	203	245	1,129	1,194	615	488	220	111	60	3	18	387
1952	6	35	688	655	1,435	818	897	144	28	2	0	0	392
1953	0	1	11	89	845	1,242	566	2,774	45	26	6	2	467
1954	0	5	108	308	203	106	325	947	33	1	0	0	169
1955	0	1	4	48	234	744	515	582	329	457	156	19	257
1956	15	15	69	76	1,055	584	981	222	7	20	20	1	255
1957	0	7	32	244	922	455	1,524	1,907	700	179	11	46	502
1958	219	2,236	724	959	518	581	1,575	2,218	401	403	54	679	880
1959	152	227	159	164	871	903	674	282	2,064	277	90	26	490
1960	22	93	293	478	821	891	217	208	42	9	20	3	258
1961	9	28	666	856	897	1,433	740	122	503	532	248	215	520
1962	145	381	2,245	1,296	751	644	491	613	187	23	3	18	566
1963	6	12	28	55	105	151	146	112	10	39	23	6	57
1964	1	3	19	64	63	261	759	200	15	5	3	12	117
1965	2	1	40	179	616	419	572	130	69	3	1	9	170
1966	1	1	20	138	1,156	195	462	885	20	0	4	1	240
1967	0	0	8	26	336	127	118	259	328	4	1	0	100
1968	0	1	15	654	174	469	642	868	236	101	209	583	329
Mean	91	186	342	698	834	760	708	708	284	117	55	103	407

Table 149 - Observed Mean Discharge in c.f.s., Sta 73655.00, Middle Fork Bayou D'Arbonne near Bernice, La., 1941-1957

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1941	0	115	847	667	423	528	262	527	155	192	160	9	323
1942	12	223	147	150	147	258	643	385	64	10	49	25	176
1943	1	5	19	93	94	382	192	29	7	2	0	0	68
1944	0	6	22	249	792	895	529	645	56	0	0	1	266
1945	0	3	275	1,271	637	1,227	980	139	49	176	63	53	406
1946	108	92	175	1,213	1,004	617	318	696	337	81	21	3	388
1947	7	268	156	707	265	685	591	338	61	6	0	0	256
1948	0	23	185	281	959	477	222	48	4	1	0	0	183
1949	0	27	51	453	512	403	228	47	13	32	16	7	148
1950	501	124	350	1,107	737	522	196	591	101	42	66	410	395
1951	134	85	117	545	705	338	253	100	78	102	4	16	206
1952	5	29	425	482	840	393	435	66	12	1	0	0	223
1953	0	1	6	61	592	723	280	1,387	16	17	2	1	257
1954	0	1	34	117	120	63	141	504	12	0	0	0	82
1955	0	1	1	24	102	484	233	321	53	50	26	1	107
1956	1	4	20	30	519	280	357	100	3	1	0	0	109
1957	0	3	9	62	395	204	872	676	298	34	3	7	213
Mean	45	59	167	441	520	498	396	388	77	43	24	31	224

Table 150 - Observed Mean Discharge in c.f.s., Sta 73658.00, Cornie Bayou near Three Creeks, Ark., 1956-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1956	--	--	--	--	--	--	130	64	4	2	1	1	--
1957	0	27	19	63	379	210	921	351	157	20	4	9	196
1958	108	751	317	479	179	265	2,059	766	348	70	11	38	449
1959	9	26	25	37	351	185	336	44	111	102	9	6	103
1960	12	13	129	238	299	526	73	39	6	2	5	4	112
1961	6	10	168	239	265	416	278	27	30	368	36	57	158
1962	215	396	1,005	984	378	299	346	314	114	19	6	18	341
1963	16	18	24	33	35	78	61	17	9	174	4	12	40
1964	2	5	30	35	32	117	548	53	12	0	6	28	72
1965	13	15	105	173	503	231	152	104	27	8	6	17	112
1966	3	6	17	27	198	44	512	587	5	2	4	6	117
1967	5	3	16	21	29	22	35	128	101	13	1	2	31
1968	0	2	18	270	115	224	367	511	163	61	50	132	159
1969	27	39	365	75	687	732	271	57	18	1	1	--	--
Mean	32	100	172	205	265	257	434	218	78	60	10	25	157

Table 151 - Observed Mean Discharge in c.f.s., Sta 73659.00, Three Creek near Three Creeks, Ark., 1956-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1956	--	--	--	--	--	--	--	11	3	1	2	2	--
1957	1	4	3	22	118	43	329	62	41	3	2	2	54
1958	14	182	90	131	60	94	680	201	107	10	9	16	132
1959	3	9	7	10	116	68	107	12	60	51	6	5	37
1960	4	4	46	46	97	181	12	10	3	2	4	3	34
1961	3	3	77	56	145	223	75	6	12	166	3	19	65
1962	45	47	313	325	122	85	106	130	53	2	1	3	102
1963	5	4	5	7	8	15	23	4	7	114	2	3	16
1964	1	2	7	18	10	54	209	5	1	0	3	3	26
1965	1	2	11	46	138	91	34	6	2	0	2	9	28
1966	1	1	3	9	83	7	114	117	1	0	1	1	28
1967	4	1	7	6	16	6	12	50	47	2	1	1	12
1968	0	2	12	172	47	87	101	164	54	24	75	104	70
1969	12	40	178	26	219	234	83	29	6	1	0	0	69
Mean	7	23	58	67	90	91	145	57	28	26	7	12	52

Table 152 - Observed Mean Discharge in c.f.s., Sta 73662.00, Little Cornie Bayou near Lillie, La., 1956-1968

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1956	9	19	41	53	503	232	176	76	13	11	1	1	94
1957	1	17	21	122	356	187	813	298	162	20	5	19	168
1958	119	977	323	493	220	320	2,202	771	349	100	31	146	504
1959	36	127	68	98	473	372	357	50	429	146	24	44	185
1960	24	39	184	200	338	513	64	91	13	5	48	7	127
1961	14	33	396	348	436	578	349	41	60	577	30	58	243
1962	128	169	746	795	332	271	285	310	120	19	8	29	267
1963	43	42	56	51	65	86	112	56	14	89	9	22	53
1964	5	12	48	82	59	188	514	59	8	1	6	7	82
1965	3	11	28	77	356	177	231	18	10	5	3	15	77
1966	4	12	25	43	283	48	255	278	3	1	15	7	81
1967	12	12	42	41	107	75	60	168	95	13	2	5	52
1968	2	12	55	551	164	343	308	557	108	91	110	159	205
Mean	30	114	156	227	284	260	440	213	106	82	22	39	164

Table 153 - Observed Mean Discharge in c.f.s., Sta 73670.00, Ouachita River at Monroe, La., 1953-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1953	700	1,400	12,900	9,406	24,550	34,260	37,590	54,760	55,540	26,050	3,235	1,617	21,790
1954	1,000	1,163	3,465	11,000	14,640	5,855	8,802	29,890	5,719	1,305	777	756	7,000
1955	2,493	3,127	3,491	6,279	13,330	16,510	36,890	21,109	11,181	5,005	2,584	2,184	10,290
1956	2,879	2,057	2,829	1,660	28,210	35,830	25,400	12,840	1,920	1,680	1,310	1,540	9,770
1957	2,010	2,400	1,840	5,516	29,250	28,140	40,500	56,180	47,780	29,340	4,903	5,247	20,990
1958	8,997	31,100	44,560	38,010	34,350	23,540	26,740	82,450	60,410	42,540	11,410	14,250	34,890
1959	17,220	10,050	9,845	10,270	22,210	37,480	28,670	13,020	17,260	6,029	5,032	4,203	15,050
1960	3,677	3,987	11,340	27,510	30,920	36,650	24,870	11,190	5,623	7,042	4,010	3,553	14,160
1961	3,587	4,433	16,832	21,039	14,536	40,726	50,237	40,019	15,118	13,426	6,487	4,998	19,286
1962	5,287	8,423	34,000	45,742	47,654	44,642	37,317	25,784	9,040	1,952	2,306	5,567	22,309
1963	7,626	6,147	4,471	4,674	4,714	15,958	9,597	9,110	1,017	4,126	1,490	947	5,822
1964	771	2,267	2,865	3,216	5,103	17,923	22,823	42,245	7,440	1,268	1,726	4,787	9,369
1965	3,452	2,570	7,252	12,503	22,282	32,613	29,890	4,245	3,930	2,855	3,526	4,810	10,827
1966	2,368	1,550	1,584	3,665	23,029	13,994	5,590	44,494	25,067	2,416	6,429	5,593	11,314
1967	3,723	2,437	3,094	7,181	7,707	8,423	7,873	25,574	21,333	7,626	3,661	2,797	8,452
1968	1,429	3,277	9,477	29,471	31,352	23,016	39,433	44,429	57,187	31,958	6,203	8,330	23,796
1969	6,448	5,597	24,255	21,287	36,000	41,100	37,633	16,403	9,163	3,735	6,300	3,077	17,583
Mean	4,333	5,410	11,417	15,201	22,931	26,862	27,638	31,396	20,866	11,079	4,199	4,367	15,453

Table 154 - Observed Mean Discharge in c.f.s., Sta 73705.00, Castor Creek near Grayson, La., 1941-1968

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1941	1	821	1,053	308	380	427	257	129	108	41	24	15	296
1942	31	747	181	194	244	574	932	974	234	93	14	9	352
1943	3	8	52	112	76	137	116	7	4	9	0	0	43
1944	22	12	36	365	322	581	376	994	6	0	2	16	227
1945	0	15	39	862	495	789	1,412	245	266	27	69	10	352
1946	141	104	133	1,753	1,843	506	238	369	418	412	132	18	505
1947	12	112	318	1,664	334	909	1,822	74	35	14	2	6	441
1948	2	164	371	325	1,366	529	311	54	11	2	0	0	261
1949	0	217	223	1,385	1,044	1,078	466	177	52	31	6	2	390
1950	23	10	106	523	1,642	320	243	646	626	54	20	21	352
1951	16	24	53	810	460	419	266	50	9	17	1	8	177
1952	2	8	122	86	389	262	590	83	7	1	1	0	129
1953	0	0	10	64	624	1,000	135	2,605	5	3	3	0	370
1954	0	0	115	162	99	45	74	722	43	0	0	0	105
1955	0	0	2	35	203	393	428	197	146	389	39	2	152
1956	2	5	28	34	870	430	492	51	3	6	0	0	160
1957	0	0	100	155	635	308	732	364	500	293	21	111	268
1958	105	1,717	313	471	254	681	309	1,135	192	401	49	632	521
1959	57	32	31	58	137	327	457	59	92	47	19	17	110
1960	23	32	118	162	533	521	50	121	8	3	12	4	132
1961	1	18	35	272	958	1,096	738	91	177	163	99	37	307
1962	11	184	1,744	759	364	454	593	499	121	29	1	3	396
1963	1	13	18	31	62	88	54	3	1	4	2	3	23
1964	0	0	23	82	56	378	454	151	7	0	1	0	95
1965	3	8	132	87	443	699	518	5	3	0	1	33	161
1966	12	18	32	302	1,739	78	470	604	24	6	7	9	274
1967	6	12	145	66	117	68	235	124	119	12	2	4	75
1968	0	0	71	695	212	376	1,253	582	109	25	73	105	291
Mean	16	152	200	422	567	481	500	396	118	74	21	38	249

Table 155 - Observed Mean Discharge in c.f.s., Sta 73710.00, Garrett Creek at Jonesboro, La., 1953-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1953	0	0	0	3	8	7	12	15	0	0	0	0	3
1954	0	0	5	3	1	0	3	5	0	0	0	0	1
1955	0	0	0	0	3	9	7	9	5	9	1	0	3
1956	0	0	0	0	9	3	5	1	0	0	0	0	1
1957	0	0	0	4	3	2	8	4	4	1	0	3	2
1958	3	16	2	3	2	6	3	7	1	12	3	16	6
1959	0	0	0	1	2	6	5	1	10	1	0	0	2
1960	0	1	3	4	8	3	0	0	0	0	0	0	1
1961	0	0	1	5	7	10	2	0	1	1	0	2	2
1962	0	1	11	5	3	2	5	4	5	0	0	0	3
1963	0	0	0	0	2	1	1	0	0	2	0	1	0
1964	0	0	1	2	1	7	10	0	0	0	0	0	1
1965	0	0	1	1	4	8	1	0	0	0	0	0	1
1966	0	0	1	1	11	0	3	3	0	0	0	0	1
1967	0	0	0	0	2	0	3	3	2	0	0	0	0
1968	0	0	2	7	1	3	9	6	0	0	0	1	2
1969	0	2	4	1	4	4	4	2	0	0	0	0	1
Mean	0	1	1	2	4	4	4	3	1	1	0	1	2

Table 156 - Observed Mean Discharge in c.f.s., Sta 73720.00, Dugdemona River near Winnfield, La., 1940-1968

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1940	7	12	81	337	2,359	579	1,678	1,123	924	677	672	21	705
1941	10	1,777	2,912	1,487	1,229	1,724	807	1,093	766	351	256	98	1,042
1942	49	2,404	831	753	717	1,329	1,652	2,274	487	183	34	46	896
1943	8	10	95	265	289	371	482	19	14	13	3	4	131
1944	7	8	23	642	794	1,981	1,428	3,336	256	8	12	74	714
1945	6	70	429	5,054	1,614	1,966	4,069	515	682	141	339	70	1,246
1946	503	235	500	4,885	4,808	1,857	1,167	1,897	1,134	1,244	138	60	1,535
1947	35	774	1,508	4,505	942	2,178	2,303	156	45	20	5	12	1,040
1948	9	135	505	515	3,162	1,486	1,139	177	150	19	6	6	609
1949	6	57	200	2,567	2,586	2,342	1,297	435	171	93	67	16	819
1950	78	52	452	2,201	3,591	1,348	758	1,553	2,571	759	200	100	1,138
1951	94	118	291	2,183	1,357	925	1,082	277	77	36	13	23	539
1952	15	21	282	317	1,365	1,122	1,307	297	33	7	13	5	398
1953	5	8	25	101	1,128	3,110	1,142	7,899	52	9	7	3	1,124
1954	1	11	249	506	416	155	408	1,631	34	7	0	0	284
1955	0	1	3	40	259	766	1,373	1,459	927	1,390	552	20	565
1956	6	15	62	70	2,402	1,026	1,802	338	18	14	5	1	479
1957	0	3	51	197	1,425	868	1,666	2,126	1,503	649	38	416	745
1958	388	5,594	1,264	1,105	879	1,657	695	3,566	619	2,156	464	2,906	1,774
1959	381	160	134	187	737	1,236	1,726	340	2,129	79	24	27	596
1960	64	102	392	786	1,596	1,797	204	214	23	33	25	19	437
1961	8	34	203	1,185	1,757	2,755	2,257	210	283	511	256	405	821
1962	38	176	3,904	1,771	1,179	1,207	1,294	1,678	245	78	4	18	966
1963	11	34	38	47	124	215	177	16	8	47	25	16	63
1964	8	15	49	193	100	694	861	631	33	8	11	13	217
1965	12	15	61	101	573	447	1,286	20	12	10	4	18	213
1966	15	15	70	246	4,231	309	353	1,589	88	22	22	13	581
1967	15	14	40	46	156	115	412	342	892	30	11	11	173
1968	10	18	167	1,250	575	1,284	3,790	2,429	498	111	166	441	894
Mean	61	409	511	1,156	1,460	1,270	1,331	1,297	506	300	116	167	715

Table 157 - Observed Mean Discharge in c.f.s., Sta 73722.00, Little River near Rochelle, La., 1958-1968

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1958	601	11,349	4,238	3,735	2,927	4,669	2,289	9,224	1,853	4,161	2,188	6,242	4,456
1959	1,821	298	254	436	1,976	3,014	4,812	1,345	2,287	527	157	173	1,424
1960	187	237	1,180	1,965	4,513	6,482	661	867	84	105	160	72	1,376
1961	35	115	384	3,338	6,521	9,447	7,520	400	788	1,649	867	723	2,648
1962	105	932	9,875	5,472	3,620	3,273	3,722	3,903	894	303	49	75	2,685
1963	35	95	161	323	737	1,008	372	98	39	150	66	61	262
1964	26	34	169	554	456	3,106	3,477	2,474	233	37	56	50	889
1965	59	164	1,062	667	3,356	2,646	5,042	84	76	61	32	175	1,118
1966	59	71	335	1,274	13,484	849	1,949	4,492	404	75	55	28	1,922
1967	101	53	571	563	919	570	2,205	2,067	1,855	128	43	25	758
1968	16	22	666	4,758	1,913	2,585	11,609	6,965	1,533	355	350	608	2,615
Mean	276	1,215	1,717	2,098	3,674	3,422	3,968	2,901	913	686	365	748	1,832

Table 158 - Observed Mean Discharge in c.f.s., Sta 73725.00, Bayou Funny Louis near Trout, La., 1939-1968

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1939	--	--	--	--	--	--	--	44	77	6	2	0	--
1940	4	1	123	50	398	81	483	101	90	334	45	8	153
1941	1	213	455	98	196	70	122	275	243	283	87	14	171
1942	38	83	47	54	333	351	284	75	25	7	16	3	109
1943	7	1	128	79	12	157	184	2	14	3	0	41	52
1944	4	3	38	256	288	343	160	311	4	1	10	5	118
1945	1	3	60	155	297	467	205	48	268	55	42	5	133
1946	2	19	41	719	799	404	20	229	79	109	22	2	203
1947	1	28	60	818	46	276	571	19	5	1	1	23	154
1948	0	85	314	106	490	219	241	10	2	1	0	0	122
1949	0	720	140	404	550	394	228	66	7	22	15	3	212
1950	4	1	39	158	723	335	70	363	249	73	11	5	169
1951	2	3	7	237	279	573	114	24	36	37	0	2	109
1952	0	1	19	44	203	235	348	191	8	3	3	0	88
1953	0	1	13	57	317	538	459	1,828	5	5	2	1	268
1954	0	0	28	35	11	50	36	750	6	1	0	1	76
1955	1	0	0	8	299	43	408	70	5	99	76	3	84
1956	2	1	2	2	312	142	35	2	1	1	1	0	41
1957	1	13	252	108	178	283	496	121	191	57	5	17	143
1958	17	454	173	246	221	403	198	104	55	156	104	158	190
1959	16	7	4	13	221	131	290	11	6	7	3	5	49
1960	2	3	78	128	315	331	29	100	1	1	11	1	83
1961	2	8	33	359	551	672	226	8	90	315	68	19	195
1962	11	241	605	449	139	96	232	111	196	6	1	3	174
1963	1	14	37	76	125	82	5	3	8	6	3	3	30
1964	0	1	8	78	36	325	482	13	9	1	1	7	80
1965	3	83	358	125	396	418	140	2	0	1	2	19	128
1966	1	7	31	196	885	51	144	34	1	1	6	7	113
1967	24	19	117	62	96	46	217	230	22	3	3	1	69
1968	1	0	197	532	107	198	634	252	17	28	8	1	164
Mean	5	69	117	194	304	266	243	179	57	54	18	11	127

Table 159 - Observed Mean Discharge in c.f.s., Sta 73730.00, Big Creek at Pollock, La., 1942-1968

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1942	--	--	--	51	140	202	174	42	41	39	25	24	--
1943	18	21	40	39	25	47	45	20	22	20	14	18	88
1944	15	19	24	90	60	71	64	113	22	16	23	29	45
1945	17	24	60	72	84	102	115	45	34	46	25	21	53
1946	28	29	40	294	278	134	71	223	96	73	35	28	110
1947	27	37	41	286	56	92	279	76	41	24	18	26	83
1948	20	62	100	57	137	78	65	45	19	15	13	14	52
1949	14	141	44	96	177	225	147	84	50	82	43	27	94
1950	40	27	65	96	403	185	61	230	157	78	35	34	117
1951	34	40	37	155	108	149	81	68	35	29	17	26	65
1952	18	20	35	34	87	60	167	81	24	21	16	12	47
1953	11	16	27	27	83	144	376	698	43	48	27	19	126
1954	16	20	61	42	28	28	35	122	22	20	11	10	34
1955	12	13	16	35	88	24	129	18	15	50	24	19	36
1956	13	14	18	19	97	42	22	15	13	9	8	6	23
1957	9	13	54	28	46	84	98	41	59	28	13	47	43
1958	36	214	60	64	69	93	281	86	48	33	65	76	93
1959	44	32	25	34	108	49	84	27	24	25	18	14	40
1960	23	25	46	58	111	93	34	33	17	13	21	14	40
1961	24	24	33	180	150	230	81	32	80	64	105	60	88
1962	28	92	208	113	58	45	43	46	33	21	21	26	61
1963	35	42	41	31	37	29	24	18	10	10	7	9	24
1964	8	19	23	30	25	103	88	24	19	13	14	13	31
1965	11	36	96	40	71	108	34	24	15	12	13	99	46
1966	13	15	46	73	474	39	63	33	15	13	13	28	68
1967	23	24	45	33	34	30	168	33	25	22	15	13	38
1968	11	12	56	147	46	48	200	75	25	33	29	20	58
Mean	21	39	51	82	114	93	112	87	37	31	24	27	62

Table 160 - Observed Mean Discharge in c.f.s., Sta 7-3555, Red River at Alexandria, La., 1929-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1929	3,230	7,274	34,260	53,560	50,100	62,780	37,780	56,690	61,650	11,740	4,290	13,890	33,000
1930	7,205	12,830	17,290	36,300	54,520	31,250	13,550	75,850	88,870	9,796	3,991	3,578	29,380
1931	12,800	8,021	37,810	23,470	27,500	38,540	23,290	19,750	5,646	3,646	8,103	3,094	17,640
1932	3,240	6,860	47,400	116,000	149,000	93,900	39,600	22,700	16,900	31,900	5,930	5,380	44,610
1933	3,420	2,310	9,770	49,900	37,400	54,400	43,100	52,300	29,000	22,400	43,600	15,500	30,290
1934	7,510	5,220	9,390	33,800	22,700	55,900	59,600	26,800	7,900	3,060	1,470	4,950	19,850
1935	3,950	5,780	16,600	30,700	42,100	48,100	30,600	117,000	125,000	60,800	10,100	8,970	41,620
1936	5,000	13,900	33,300	11,300	9,430	9,940	5,350	19,900	13,000	5,550	2,120	3,440	11,050
1937	23,400	14,700	12,900	69,800	57,900	42,000	43,900	24,500	18,800	6,510	5,500	12,800	27,520
1938	10,100	18,700	26,400	72,900	106,000	87,000	111,000	42,100	33,400	9,860	6,460	3,130	43,420
1939	2,220	3,630	3,320	21,300	48,400	54,100	66,300	23,300	10,900	8,260	3,130	2,330	20,400
1940	1,628	1,828	5,271	6,690	17,300	9,719	35,370	41,550	50,700	55,970	20,980	7,267	21,180
1941	2,638	18,880	67,960	60,080	43,670	54,640	49,640	103,300	90,590	38,760	11,920	10,060	46,070
1942	35,020	60,220	28,780	25,650	21,340	38,240	90,740	13,360	51,920	19,880	8,823	17,770	44,400
1943	9,862	17,780	8,828	27,850	12,520	19,440	42,210	43,230	37,010	7,794	2,940	2,190	19,300
1944	2,252	3,221	4,910	18,650	41,020	76,350	63,230	108,200	46,910	5,347	2,675	3,995	31,360
1945	2,278	5,099	21,320	65,920	46,130	147,800	198,300	95,870	68,140	59,840	22,260	8,565	61,830
1946	59,170	21,660	16,620	82,990	110,900	75,390	56,740	80,820	82,980	17,060	7,015	9,320	51,340
1947	5,290	70,520	77,650	63,390	30,880	46,190	64,780	90,080	53,280	13,150	5,135	9,848	44,230
1948	4,940	12,760	41,610	48,830	70,690	86,890	38,800	50,080	24,250	20,250	5,485	3,837	33,990
1949	3,074	6,933	6,854	36,730	97,040	58,770	48,030	38,580	40,140	13,510	8,185	4,894	29,740
1950	17,970	20,700	17,140	91,680	126,200	61,770	22,020	107,000	51,830	25,550	32,970	60,830	54,230
1951	38,500	10,610	8,855	25,190	52,740	46,040	27,970	27,690	67,980	49,880	7,635	6,277	30,550
1952	4,748	12,520	16,060	21,170	31,350	37,250	69,440	54,510	17,020	5,385	4,914	3,828	23,110
1953	3,005	3,500	20,980	17,530	31,810	53,950	44,280	152,200	45,920	15,330	18,410	5,823	34,520
1954	4,213	3,799	10,170	19,320	24,780	11,320	16,160	59,470	30,420	7,305	4,560	3,295	16,190
1955	16,850	15,840	7,539	13,980	25,104	33,400	45,750	24,130	23,290	13,840	16,540	6,199	20,140
1956	24,580	6,223	7,116	6,227	47,370	20,660	15,870	22,330	6,462	3,041	2,335	1,855	13,550
1957	1,598	1,624	3,285	6,495	30,140	27,430	81,120	162,500	151,600	57,300	13,960	15,110	45,970
1958	29,960	89,810	54,390	56,990	38,230	47,290	41,880	137,300	36,100	33,060	18,830	21,840	50,610
1959	13,030	13,440	10,210	10,160	26,880	34,370	34,260	20,210	20,570	14,740	20,020	7,502	18,720
1960	27,130	12,490	34,560	59,750	50,320	47,170	15,850	27,300	17,760	12,200	10,760	6,172	26,810
1961	11,560	16,430	53,010	57,030	42,660	54,600	75,980	28,570	17,130	28,060	16,330	17,640	34,890
1962	16,190	21,600	78,960	52,550	56,090	49,920	41,080	36,920	29,470	13,510	6,759	11,590	34,470
1963	17,220	14,550	27,700	17,160	9,871	20,930	11,980	20,600	5,901	7,840	5,524	3,881	13,680
1964	2,160	1,962	3,471	4,484	5,269	24,450	31,370	40,840	7,670	4,248	3,529	7,900	11,480
1965	14,240	12,030	15,450	15,650	45,250	37,840	26,340	19,580	21,870	8,681	5,403	5,310	18,780
1966	7,200	4,500	6,500	9,210	36,330	13,790	16,760	105,100	24,470	20,350	11,550	8,950	22,030
1967	9,640	5,920	6,250	11,080	8,890	8,760	32,510	53,940	47,770	17,520	5,490	15,770	18,630
1968	6,050	14,210	21,880	37,900	41,240	59,970	101,500	104,400	84,330	26,900	13,830	19,620	44,220
1969	13,480	12,300	52,400	29,320	87,960	85,940	66,900	89,710	32,530	8,952	4,932	5,660	44,350
1970	9,161	9,377	10,710	30,710	27,930	69,400	35,300	52,480	15,770	6,393	9,416	7,897	23,750
Mean	11,827	14,799	23,688	36,890	46,261	48,514	48,006	59,351	40,782	19,171	10,091	9,470	31,021

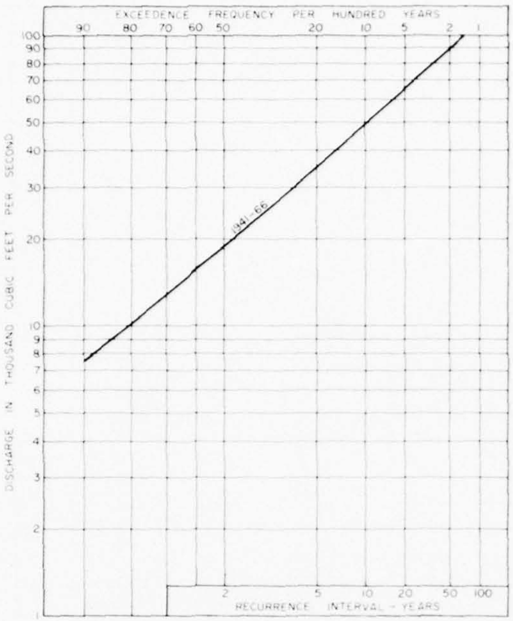


FIGURE 211 7-3560 FREQUENCY CURVE OF ANNUAL PEAK FLOWS OUACHITA RIVER NEAR MT. IDA, ARK.

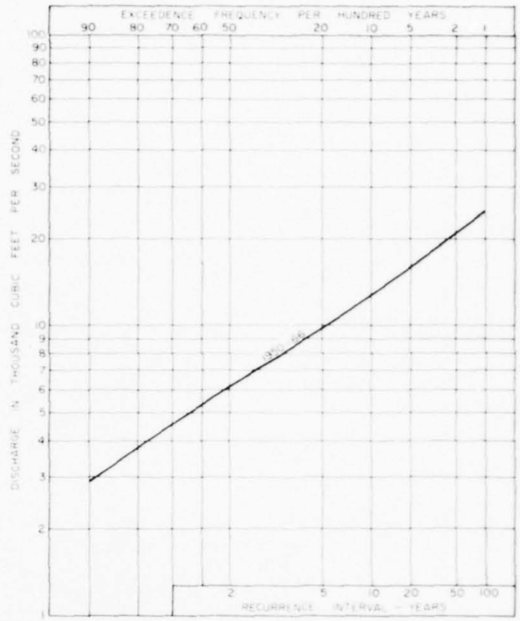


FIGURE 212 7-3565 FREQUENCY CURVE OF ANNUAL PEAK FLOWS SOUTH FORK OUACHITA RIVER NEAR MT. IDA, ARK.

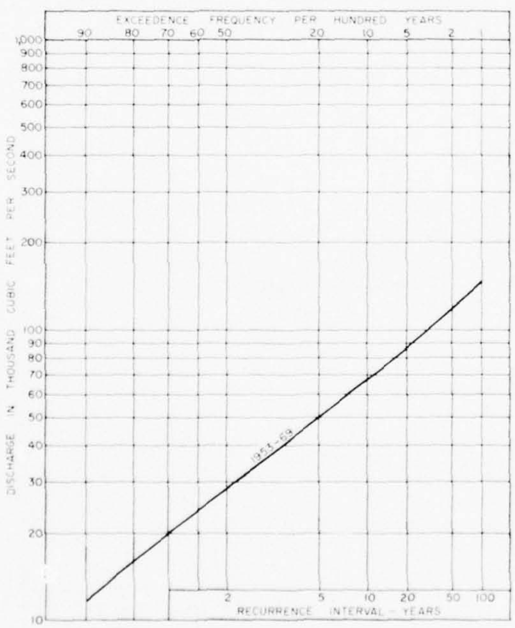


FIGURE 213 7-3595 FREQUENCY CURVE OF ANNUAL PEAK FLOWS OUACHITA RIVER NEAR MALVERN, ARK.

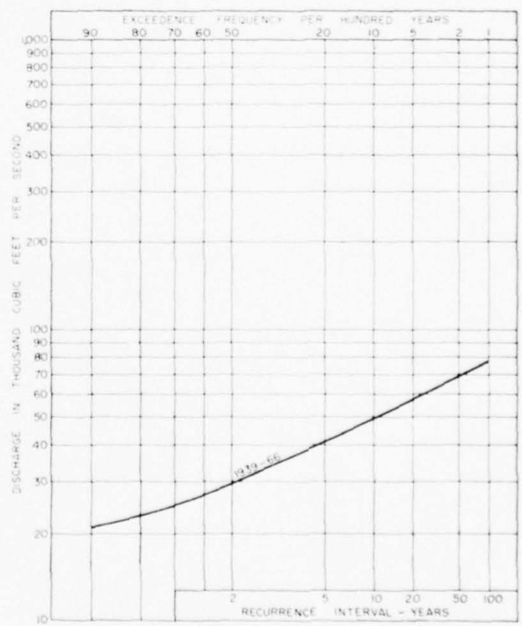


FIGURE 214 7-3598 FREQUENCY CURVE OF ANNUAL PEAK FLOWS CADDO RIVER NEAR ALPINE, ARK.

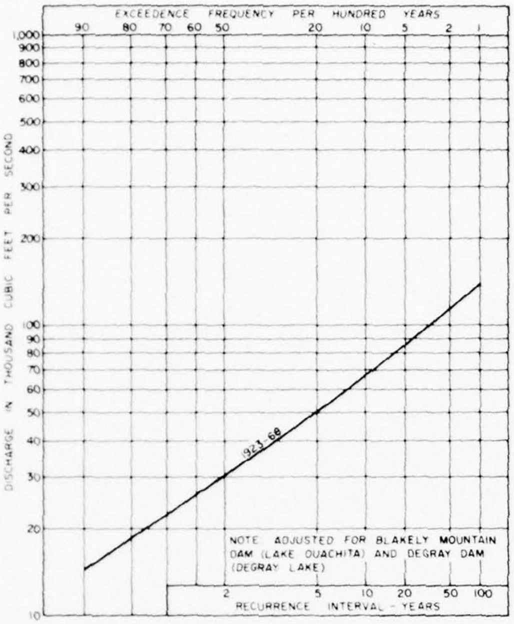


FIGURE 215 7-3600 FREQUENCY CURVE OF ANNUAL PEAK FLOWS OUACHITA RIVER NEAR ARKADELPHIA, ARK.

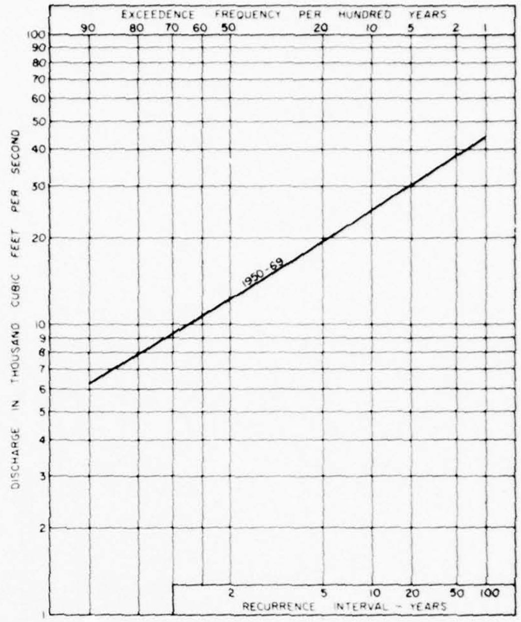


FIGURE 216 7-3610 FREQUENCY CURVE OF ANNUAL PEAK FLOWS LITTLE MISSOURI RIVER NEAR MURFREESBORO, ARK.

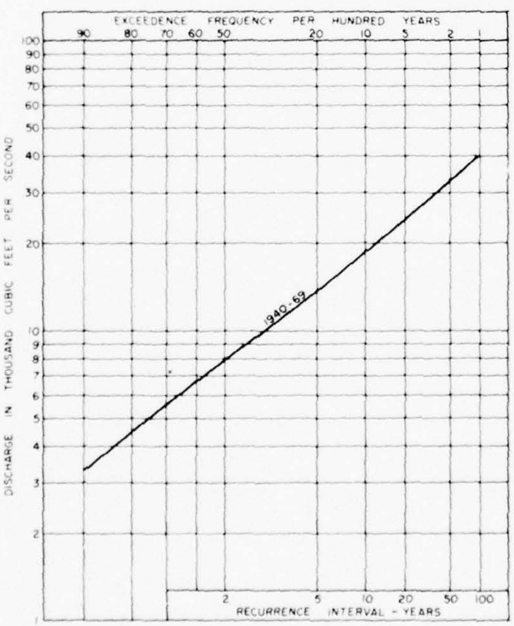


FIGURE 217 7-3612 FREQUENCY CURVE OF ANNUAL PEAK FLOWS OZAN CREEK NEAR McCASKILL, ARK.

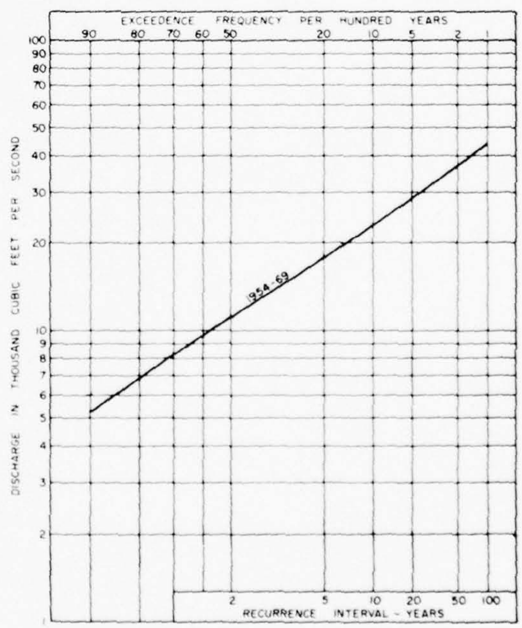


FIGURE 218 7-3615 FREQUENCY CURVE OF ANNUAL PEAK FLOWS ANTOINE RIVER AT ANTOINE, ARK.

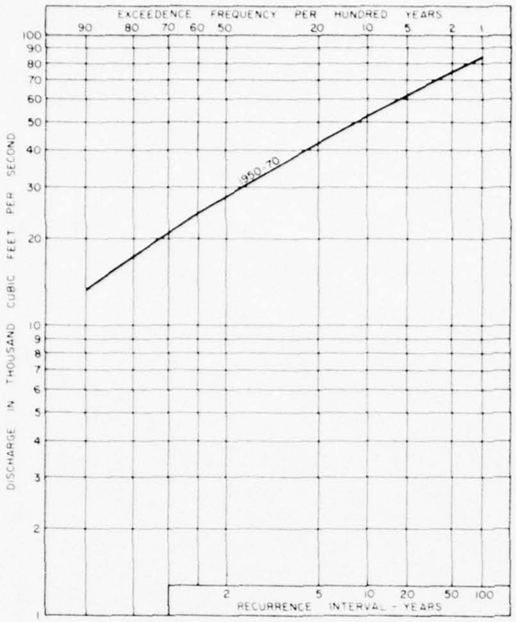


FIGURE 219 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3616 LITTLE MISSOURI RIVER NEAR BOUGHTON, ARK.

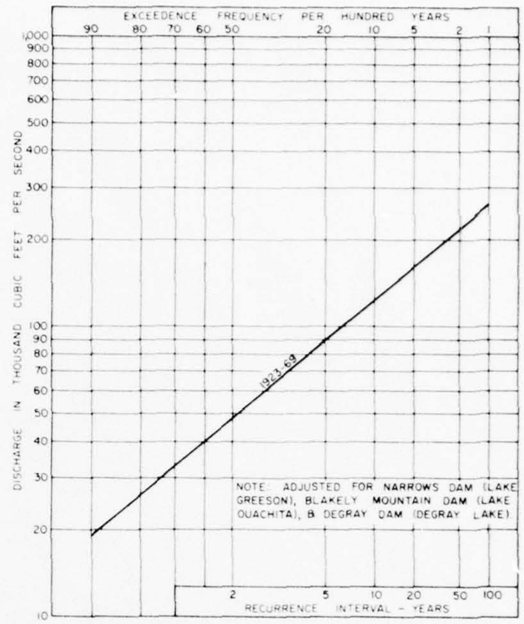


FIGURE 220 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3620 OUACHITA RIVER AT CAMDEN, ARK.

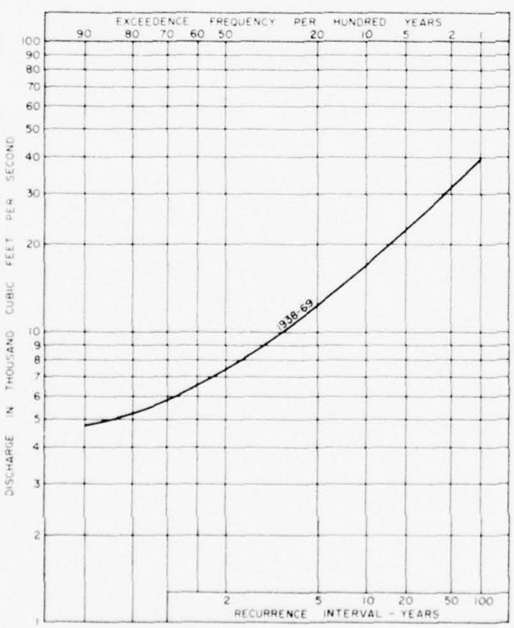


FIGURE 221 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3621 SMACKOVER CREEK NEAR SMACKOVER, ARK.

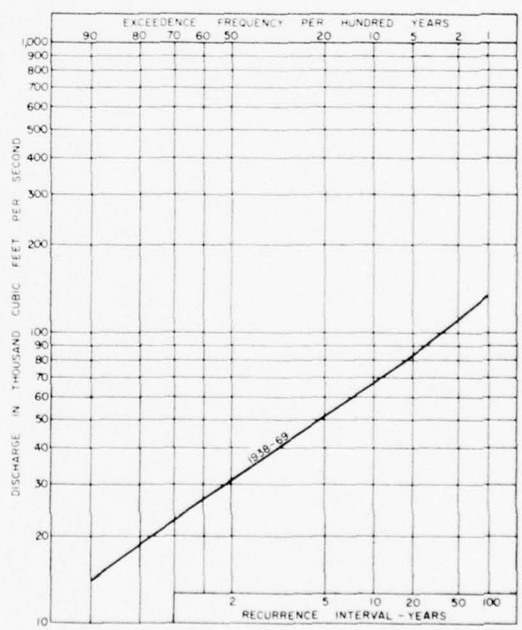


FIGURE 222 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3630 SALINE RIVER AT BENTON, ARK.

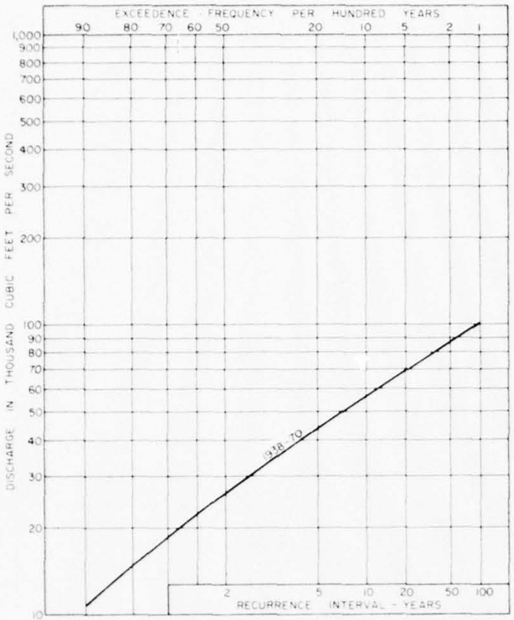


FIGURE 223 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3635 SALINE RIVER AT RYE, ARK

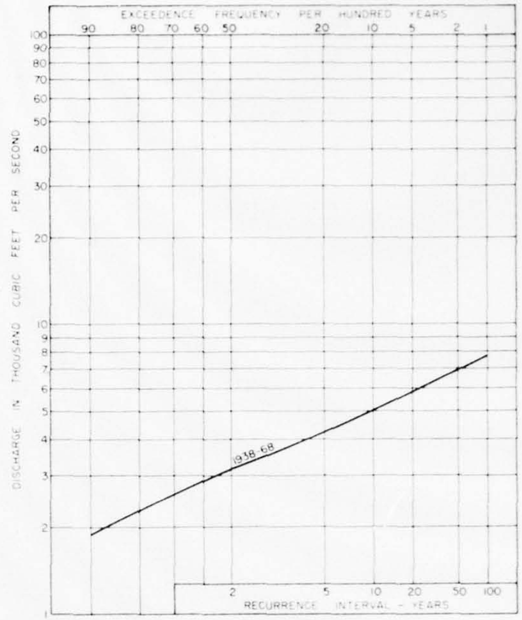


FIGURE 224 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3641.5 BAYOU BARTHOLOMEW NEAR McGEHEE, ARK

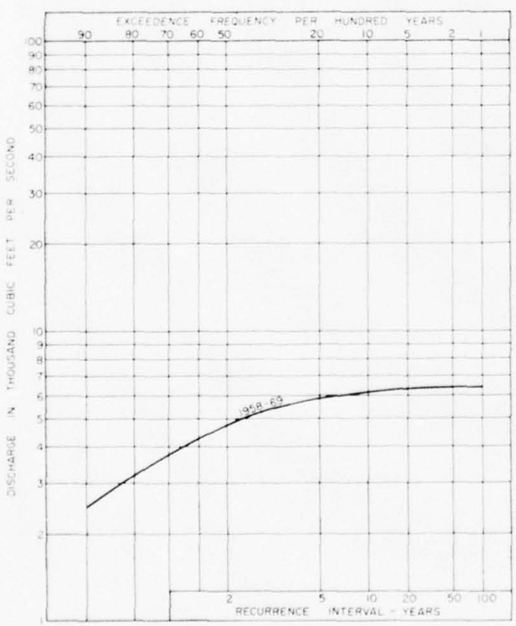


FIGURE 225 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3642 BAYOU BARTHOLOMEW NEAR JONES, LA

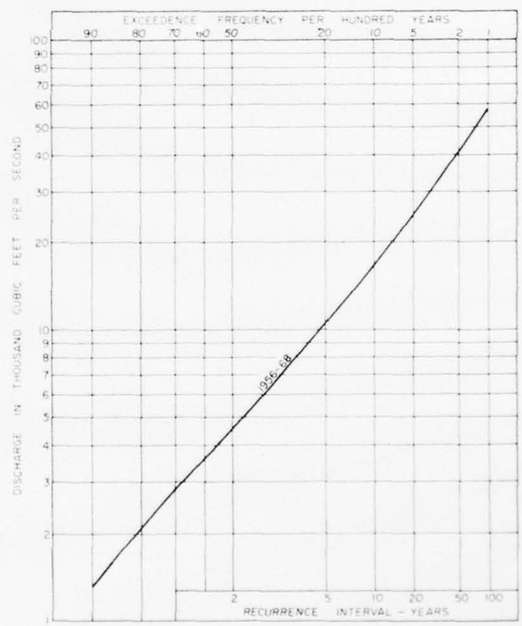


FIGURE 226 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3643 CHEMIN-A-HAUT BAYOU NEAR BEEKMAN, LA

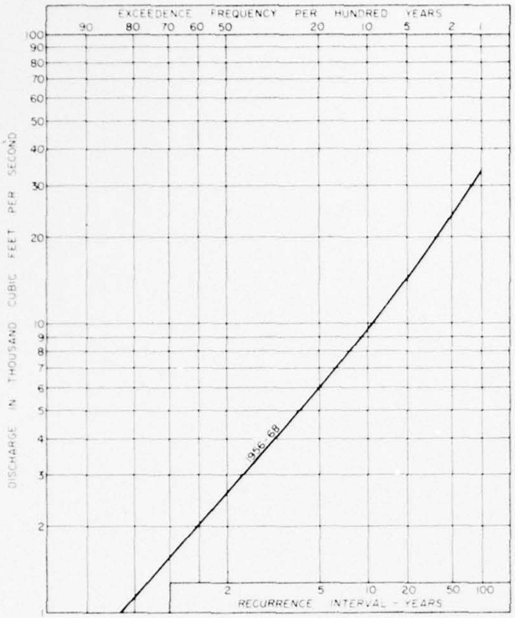


FIGURE 227 7-3647 FREQUENCY CURVE OF ANNUAL PEAK FLOWS BAYOU DE L'OUTRE NEAR LARAN, LA

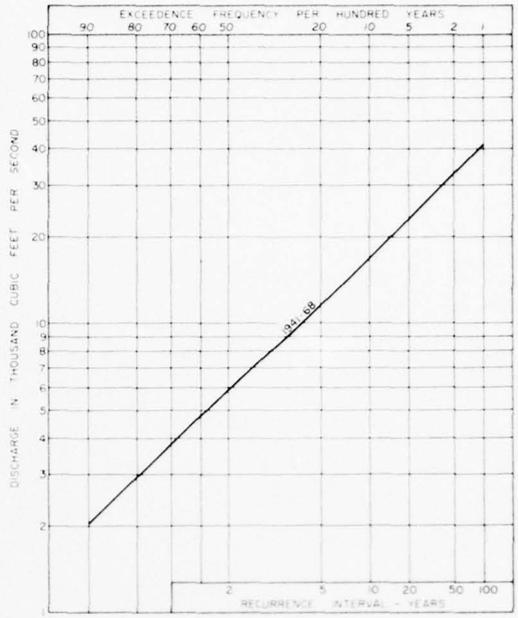


FIGURE 228 7-3650 FREQUENCY CURVE OF ANNUAL PEAK FLOWS BAYOU D'ARBONNE NEAR DUBACH, LA

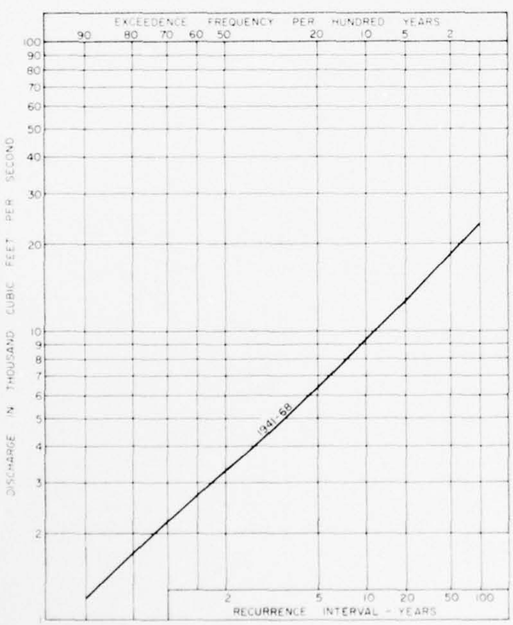


FIGURE 229 7-3655 FREQUENCY CURVE OF ANNUAL PEAK FLOWS MIDDLE FORK BAYOU D'ARBONNE NEAR BERNICE, LA

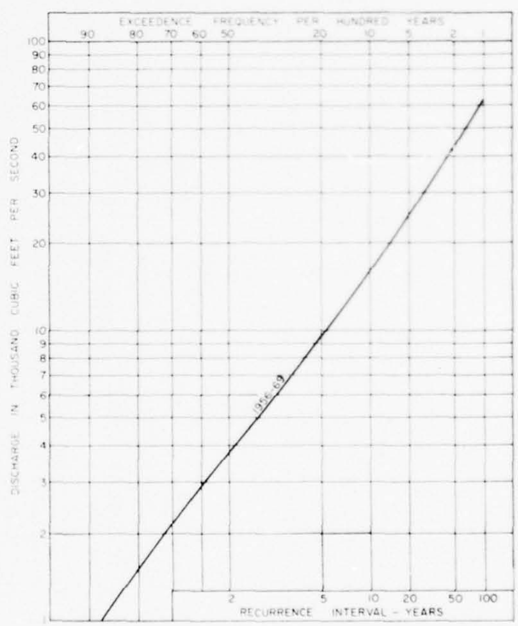


FIGURE 230 7-3658 FREQUENCY CURVE OF ANNUAL PEAK FLOWS CORNIE BAYOU NEAR THREE CREEKS, ARK

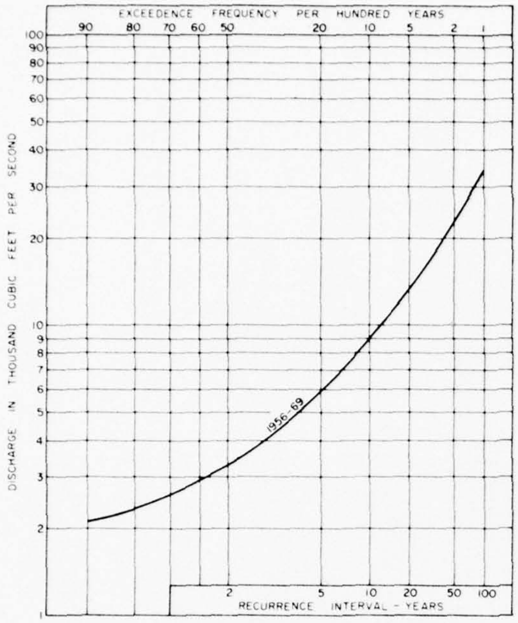


FIGURE 231 7-3659 FREQUENCY CURVE OF ANNUAL PEAK FLOWS THREE CREEK NEAR THREE CREEKS, ARK

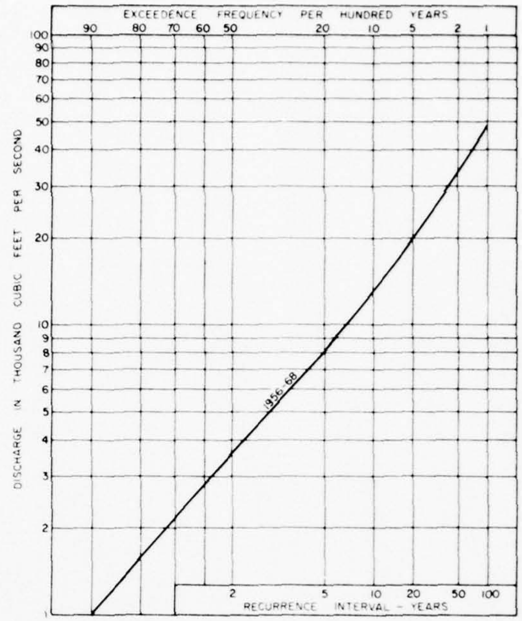


FIGURE 232 7-3662 FREQUENCY CURVE OF ANNUAL PEAK FLOWS LITTLE CORNIE BAYOU NEAR LILLIE, LA

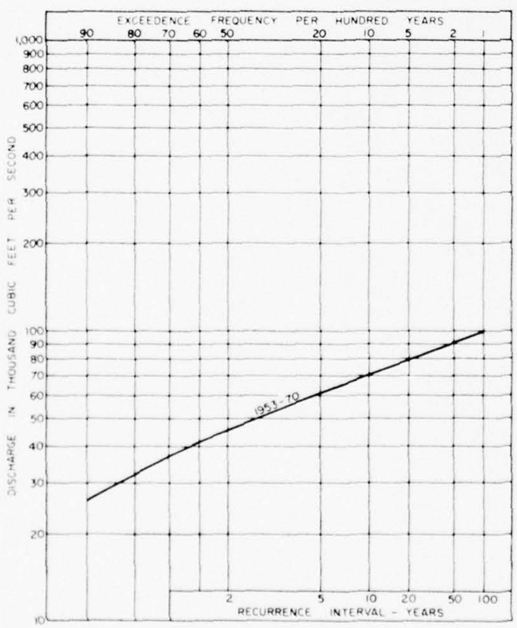


FIGURE 233 7-3670 FREQUENCY CURVE OF ANNUAL PEAK FLOWS OUACHITA RIVER AT MONROE, LA

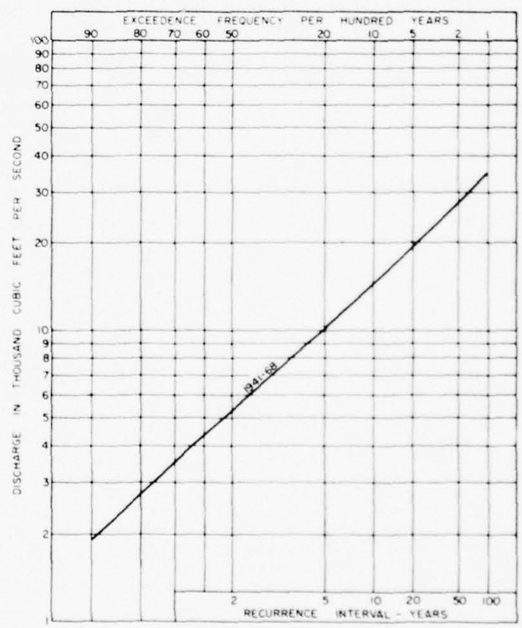


FIGURE 234 7-3705 FREQUENCY CURVE OF ANNUAL PEAK FLOWS CASTOR CREEK AT GRAYSON, LA

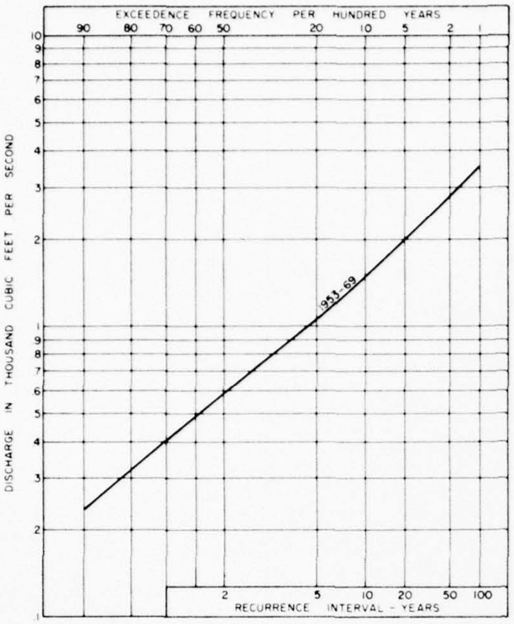


FIGURE 235 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3710 GARRETT CREEK AT JONESBORO, LA

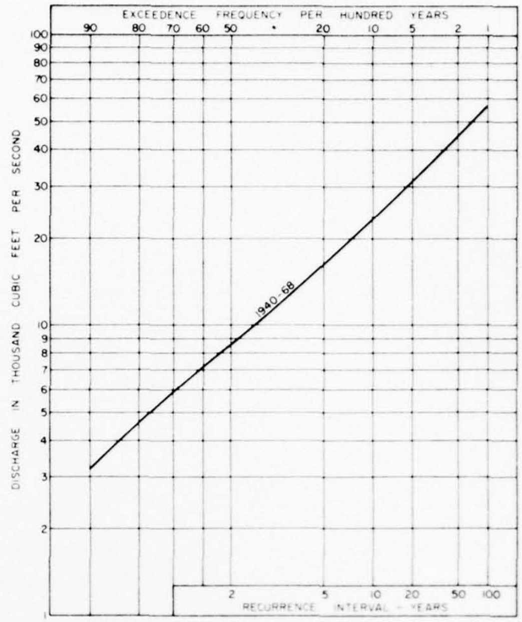


FIGURE 236 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3720 DUGDEMONA RIVER AT WINNFIELD, LA

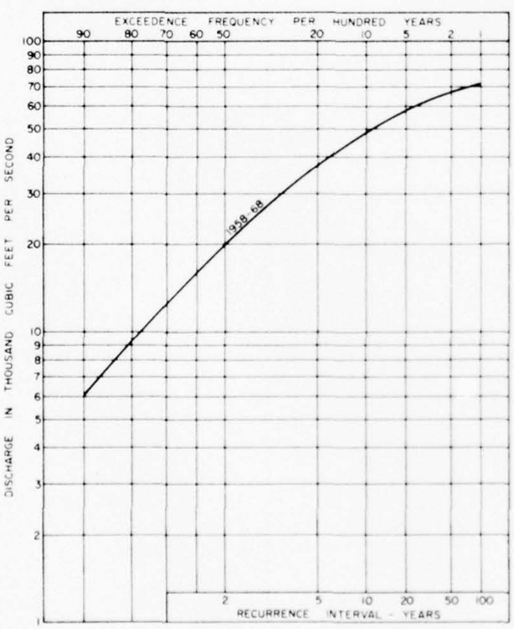


FIGURE 237 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3722 LITTLE RIVER NEAR ROCHELLE, LA

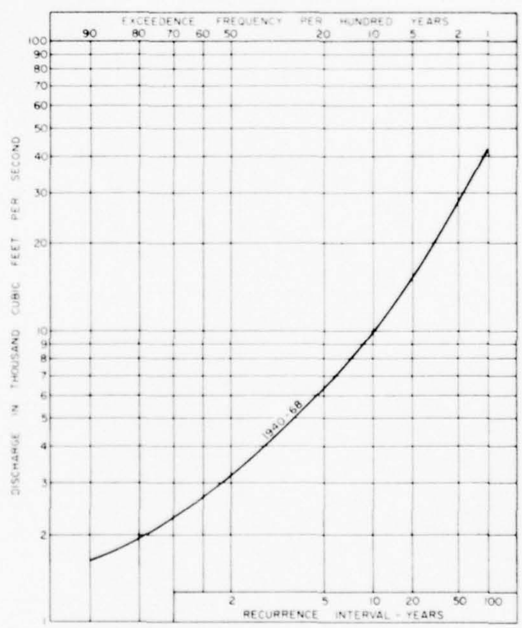


FIGURE 238 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3725 BAYOU FUNNY LOUIS NEAR TROUT, LA

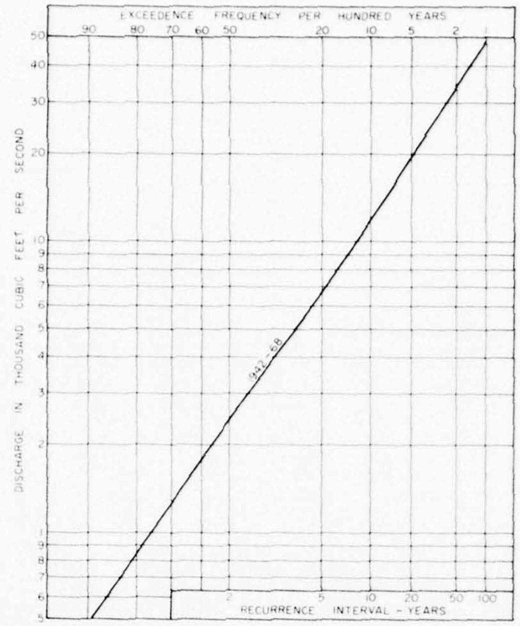


FIGURE 239 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3730 BIG CREEK AT POLLOCK, LA

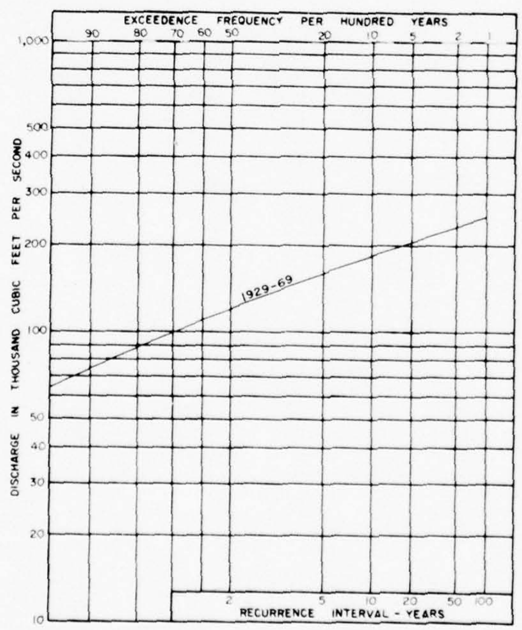


FIGURE 240 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3555 RED RIVER AT ALEXANDRIA, LA

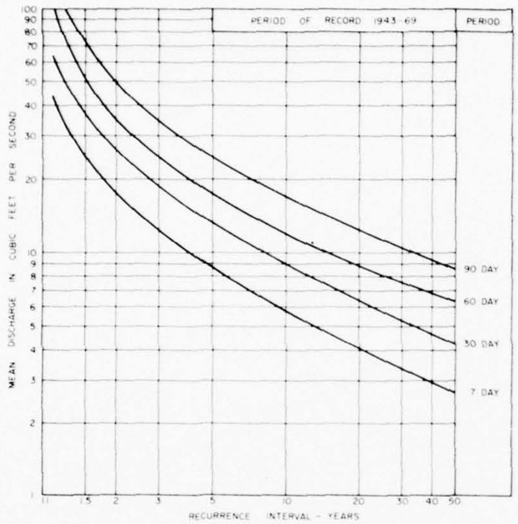


FIGURE 241 LOW FLOW FREQUENCY CURVES
7-3560 OUACHITA RIVER NEAR MT. IDA, ARK

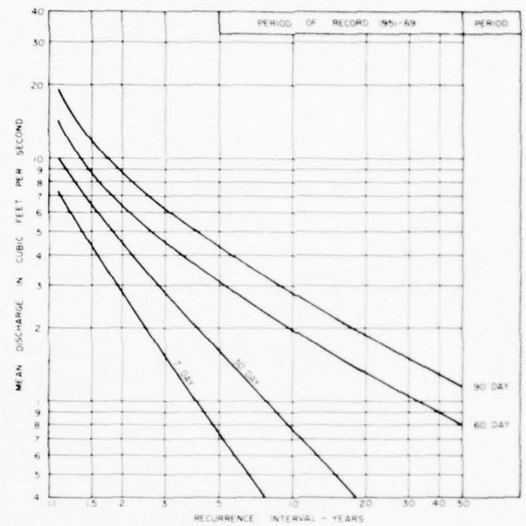


FIGURE 242 LOW FLOW FREQUENCY CURVES
7-3565 SOUTH FORK, OUACHITA RIVER AT MT. IDA, ARK

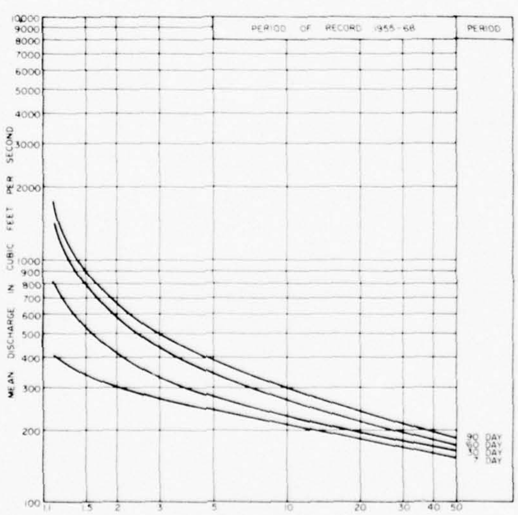


FIGURE 243 LOW FLOW FREQUENCY CURVES
7-3595 OUACHITA RIVER NEAR MALVERN, ARK

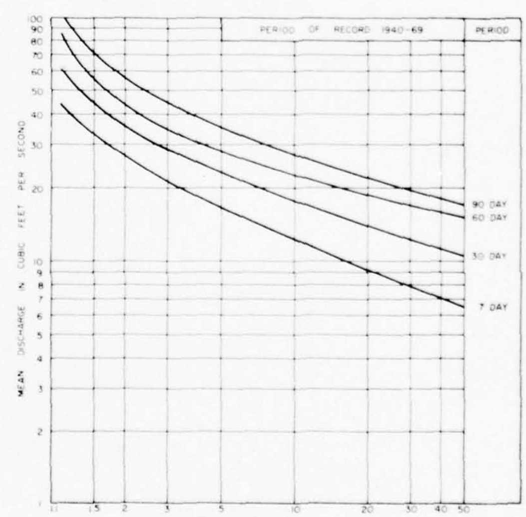


FIGURE 244 LOW FLOW FREQUENCY CURVES
7-3598 CADDO RIVER NEAR ALPINE, ARK

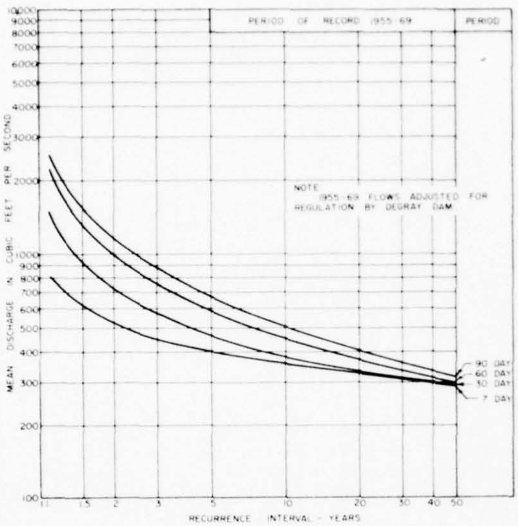


FIGURE 245 LOW FLOW FREQUENCY CURVES
7-3600 OUACHITA RIVER AT ARKADELPHIA, ARK

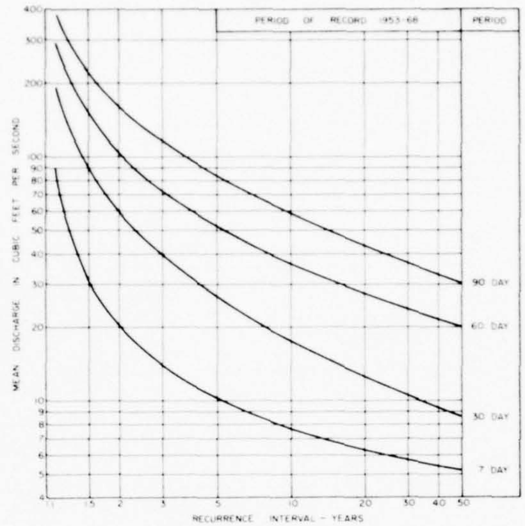


FIGURE 246 LOW FLOW FREQUENCY CURVES
7-3610 LITTLE MISSOURI RIVER NEAR MURFREESBORO, ARK

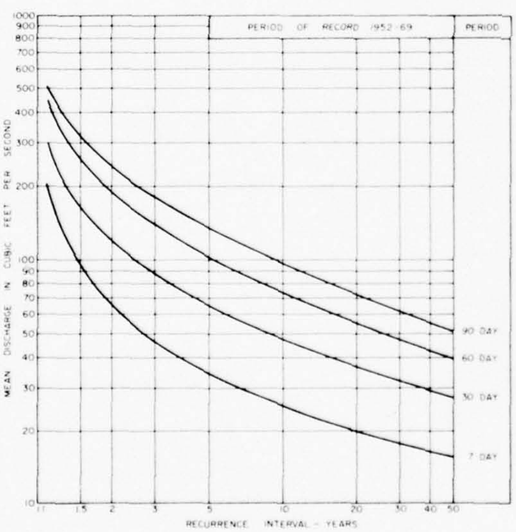


FIGURE 247 LOW FLOW FREQUENCY CURVES
7-3616 LITTLE MISSOURI RIVER NEAR BOUGHTON, ARK

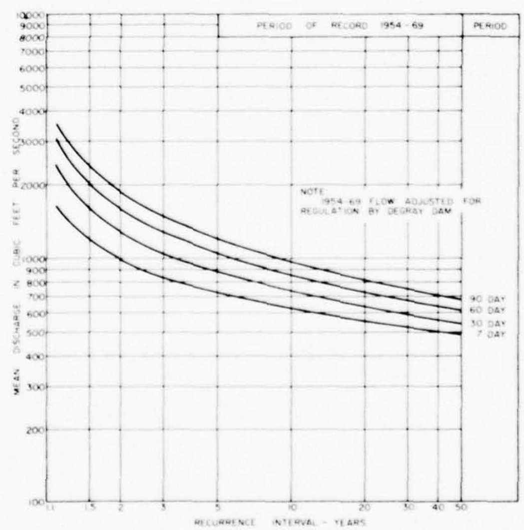


FIGURE 248 LOW FLOW FREQUENCY CURVES
7-3620 OUACHITA RIVER AT CAMDEN, ARK

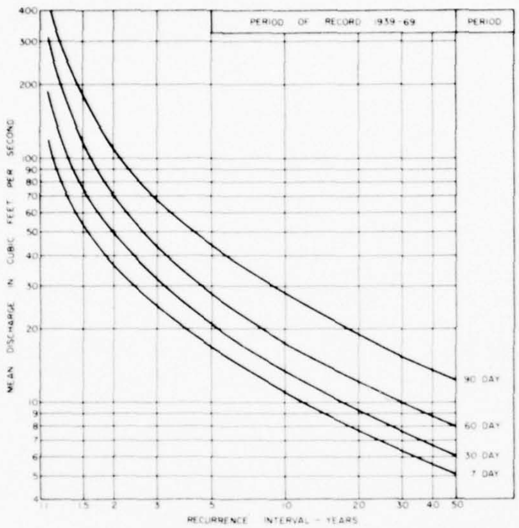


FIGURE 249 LOW FLOW FREQUENCY CURVES
7-3635 SALINE RIVER NEAR RYE, ARK.

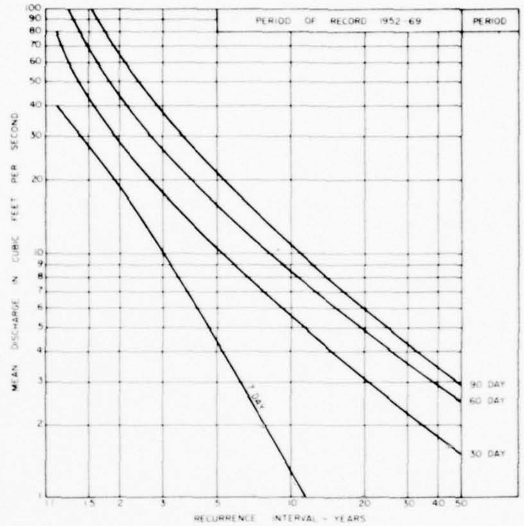


FIGURE 250 LOW FLOW FREQUENCY CURVES
7-3630 SALINE RIVER AT BENTON, ARK.

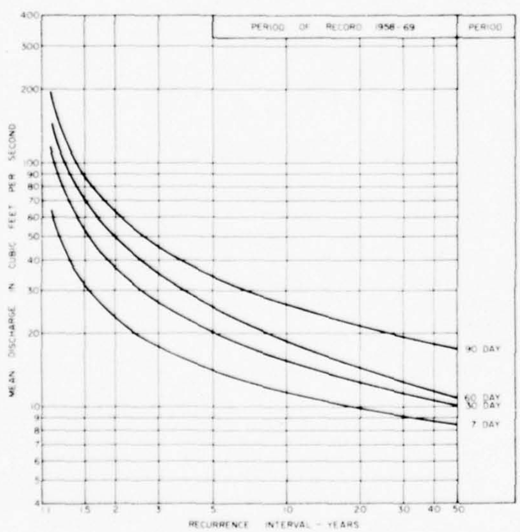


FIGURE 251 LOW FLOW FREQUENCY CURVES
7-3641.5 BAYOU BARTHOLOMEW NEAR McGEHEE, ARK.

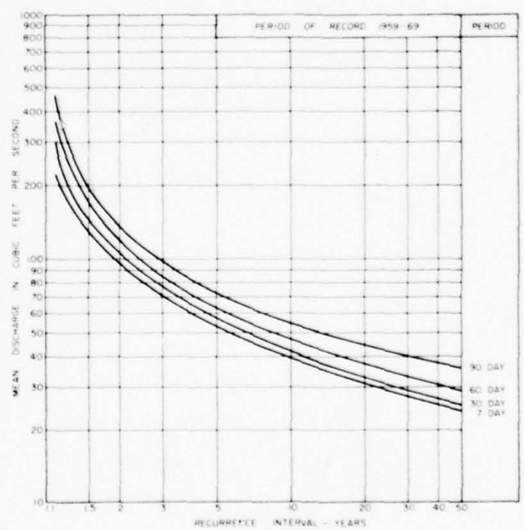


FIGURE 252 LOW FLOW FREQUENCY CURVES
7-3642 BAYOU BARTHOLOMEW NEAR JONES, LA.

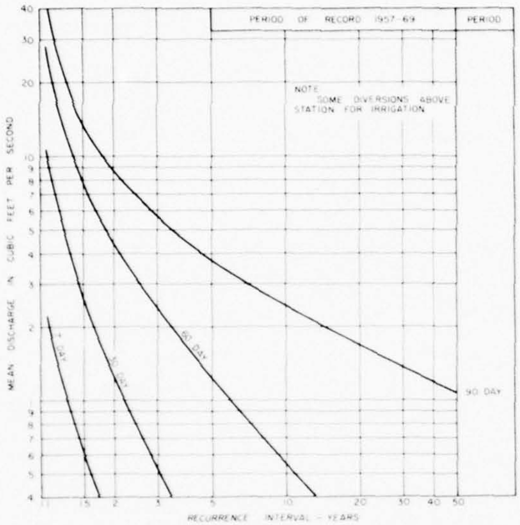


FIGURE 253 LOW FLOW FREQUENCY CURVES
7-3643 CHEMIN-A-HAUT BAYOU NEAR BEEKMAN, LA

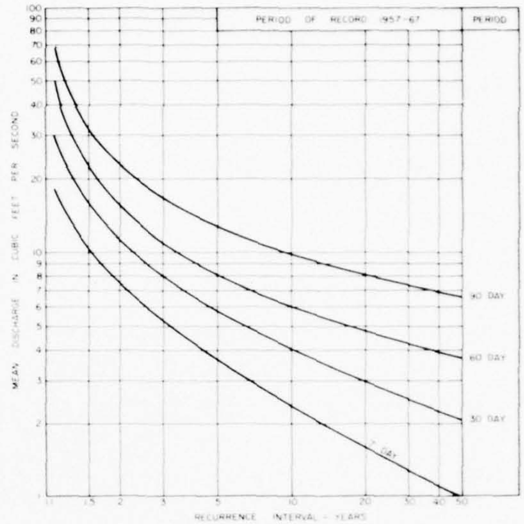


FIGURE 254 LOW FLOW FREQUENCY CURVES
7-3647 BAYOU DE LOUTRE NEAR LARAN, LA

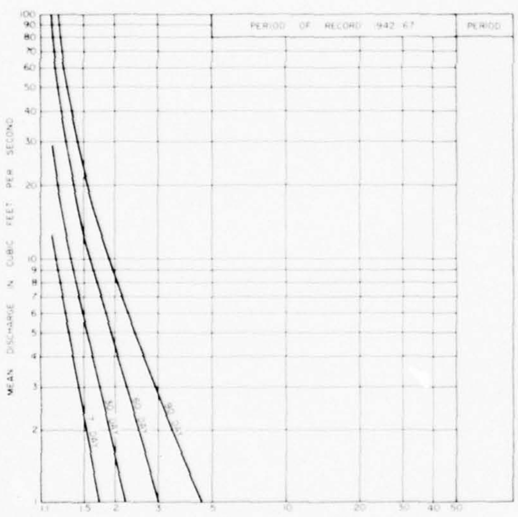


FIGURE 255 LOW FLOW FREQUENCY CURVES
7-3650 BAYOU D'ARBONNE NEAR DUBACH, LA

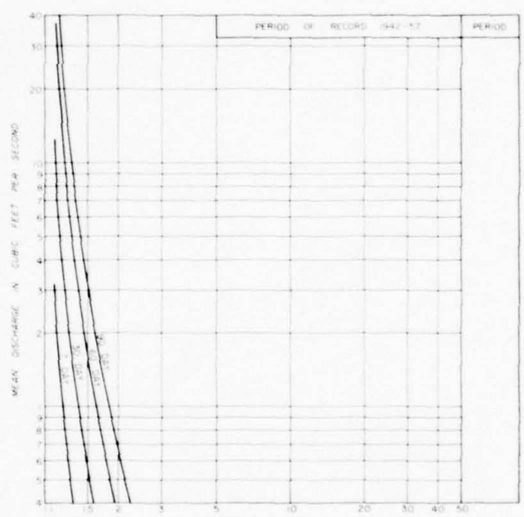


FIGURE 256 LOW FLOW FREQUENCY CURVES
7-3655 MIDDLE FORK, BAYOU D'ARBONNE NEAR BERNICE, LA

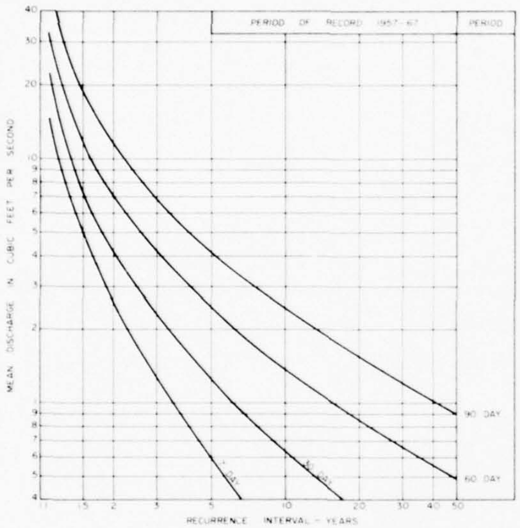


FIGURE 257 LOW FLOW FREQUENCY CURVES
7-3662 LITTLE CORNEY BAYOU NEAR LILLIE, LA

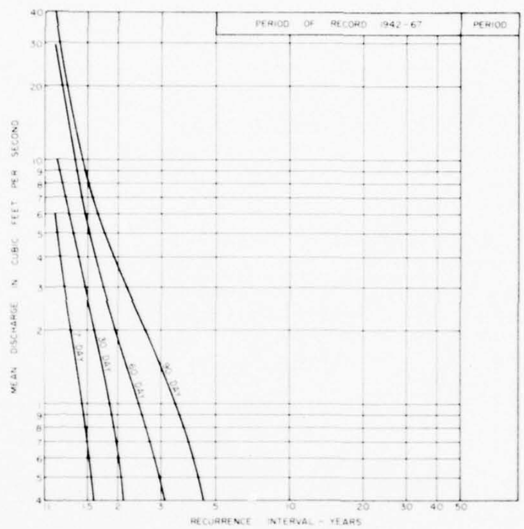


FIGURE 258 LOW FLOW FREQUENCY CURVES
7-3705 CASTOR CREEK NEAR GRAYSON, LA

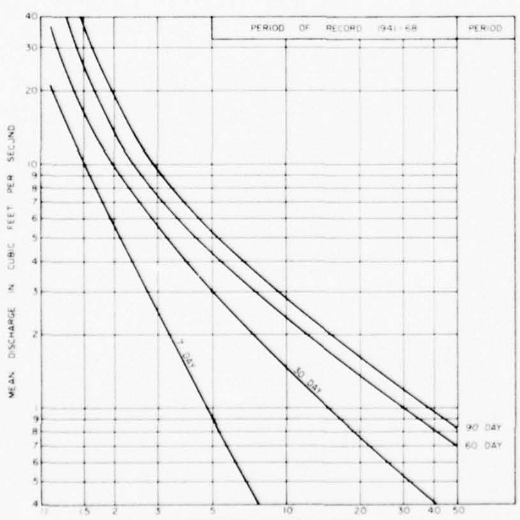


FIGURE 259 LOW FLOW FREQUENCY CURVES
7-3720 DUGDEMONA RIVER NEAR WINNFIELD, LA

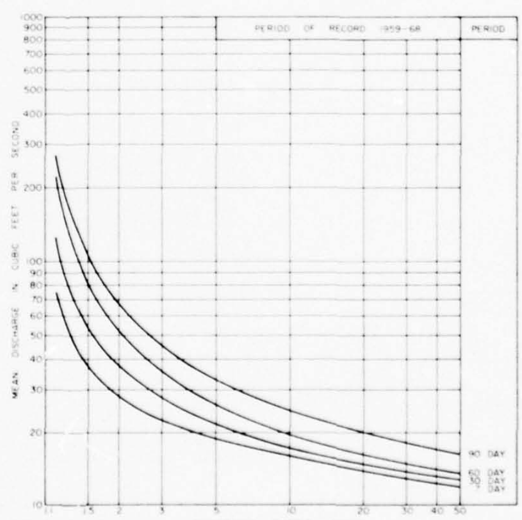


FIGURE 260 LOW FLOW FREQUENCY CURVES
7-3722 LITTLE RIVER NEAR ROCHELLE, LA

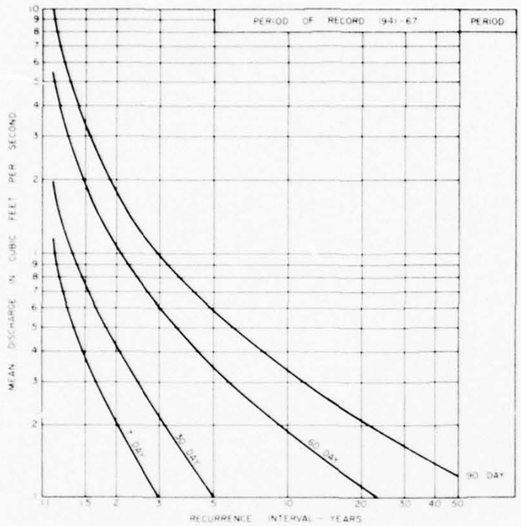


FIGURE 261 LOW FLOW FREQUENCY CURVES
7-3725 BAYOU FUNNY LOUIS NEAR TROUT, LA

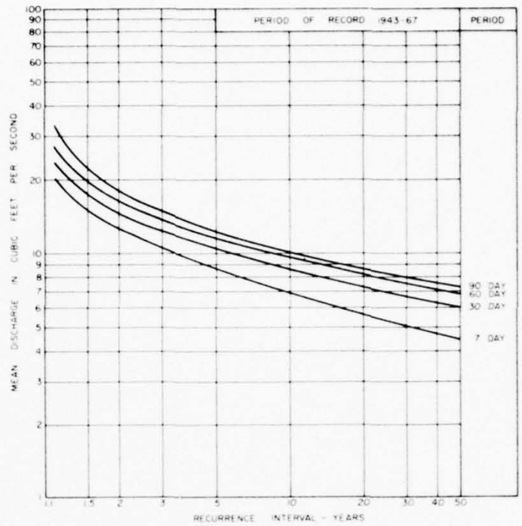


FIGURE 262 LOW FLOW FREQUENCY CURVES
7-3730 BIG CREEK AT POLLOCK, LA

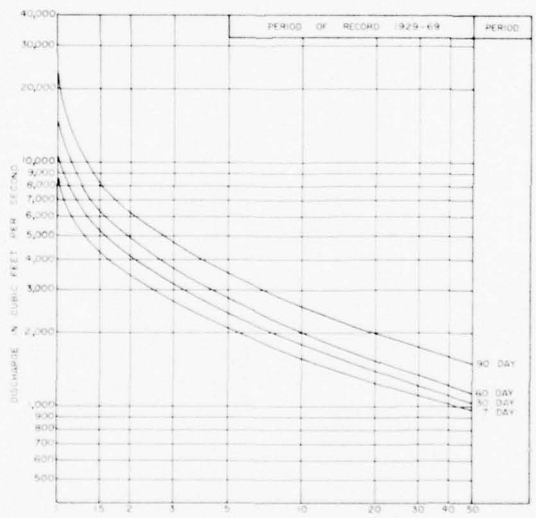


FIGURE 263 LOW FLOW FREQUENCY CURVES
7-3555 RED RIVER AT ALEXANDRIA, LA

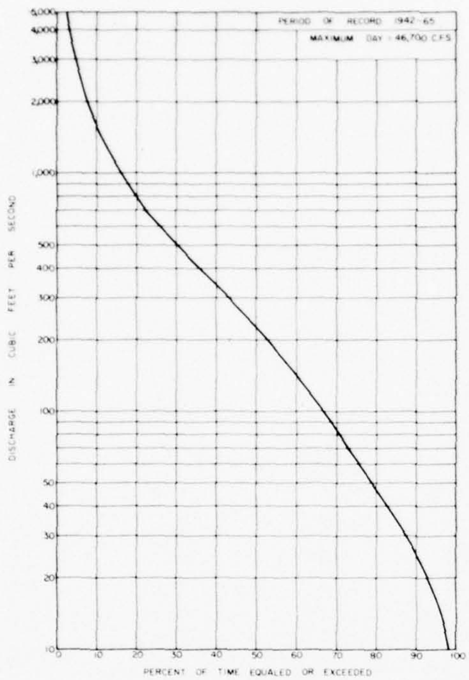


FIGURE 264 DURATION CURVE
7-3560 OUACHITA RIVER NEAR MT. IDA, ARK.

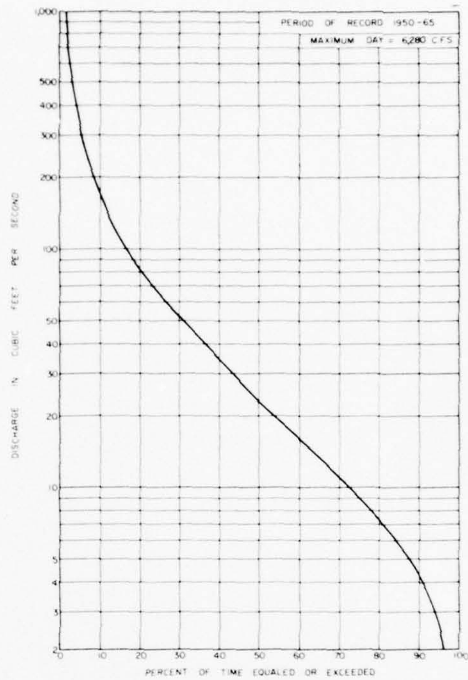


FIGURE 265 DURATION CURVE
7-3565 SOUTH FORK OUACHITA RIVER AT MT. IDA, ARK.

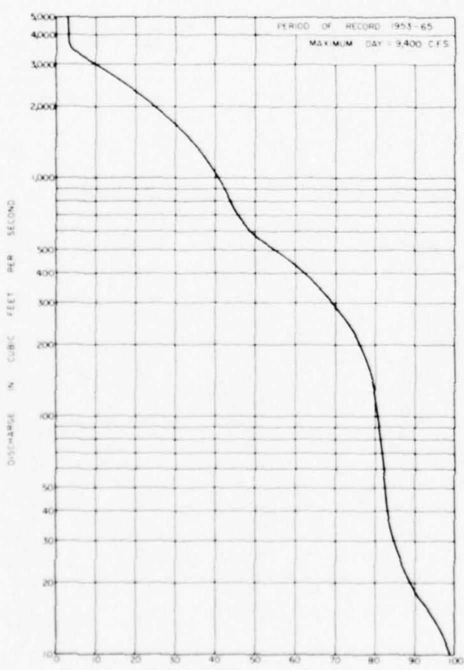


FIGURE 266 DURATION CURVE
7-357501 OUACHITA RIVER AT BLAKELY MT. DAM NEAR HOT SPRINGS, ARK.

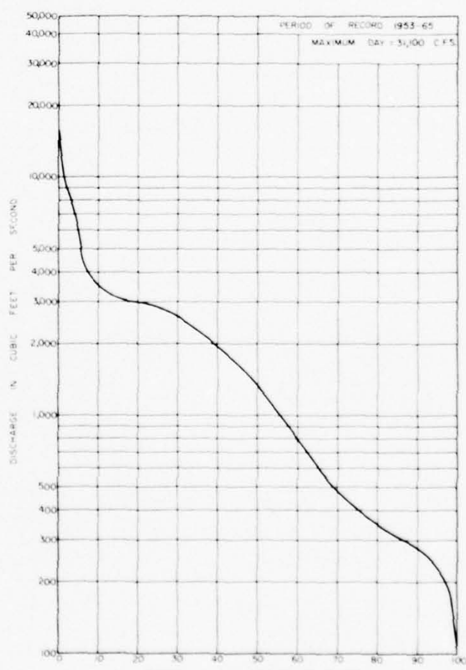


FIGURE 267 DURATION CURVE
7-3595 OUACHITA RIVER NEAR MALVERN, ARK.

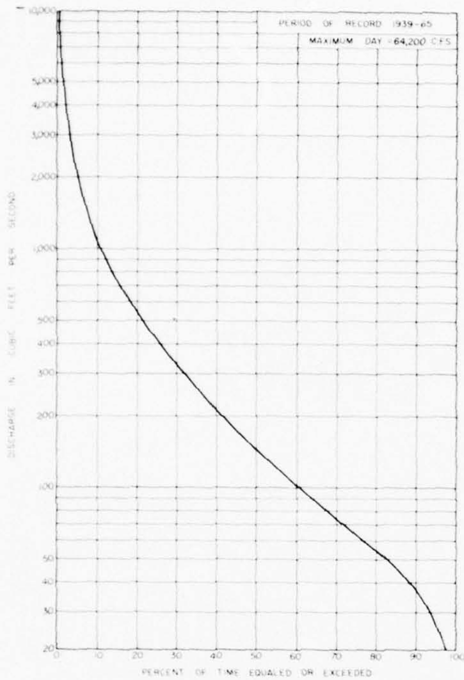


FIGURE 268 DURATION CURVE
7-3598 CADDO RIVER NEAR ALPINE, ARK.

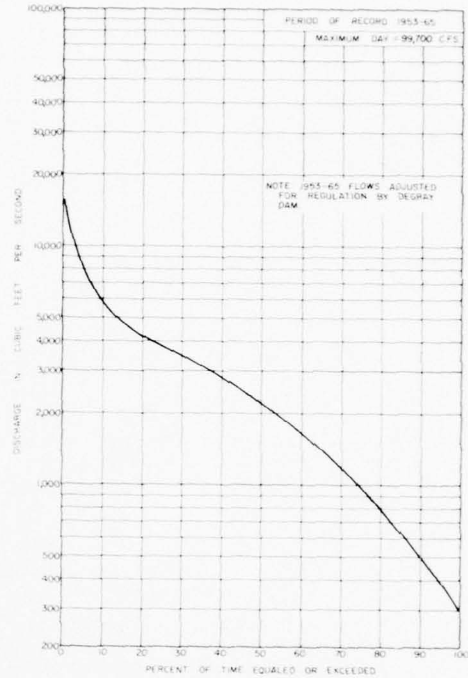


FIGURE 269 DURATION CURVE
7-3600 OUACHITA RIVER AT ARKADELPHIA, ARK.

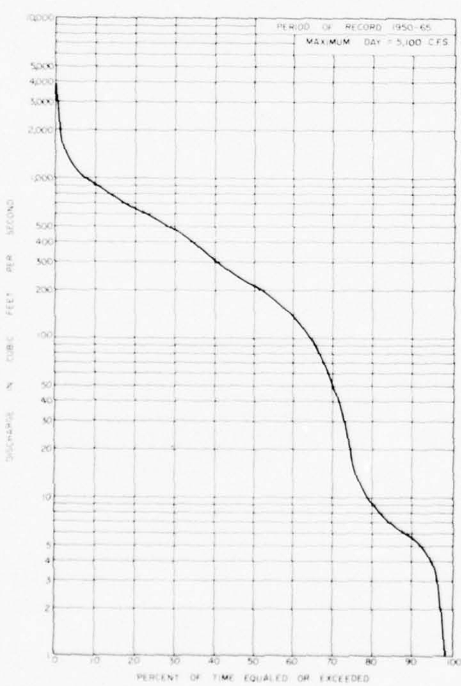


FIGURE 270 DURATION CURVE
7-3605.01 LITTLE MISSOURI RIVER AT NARROWS DAM NEAR MURFREESBORO, ARK.

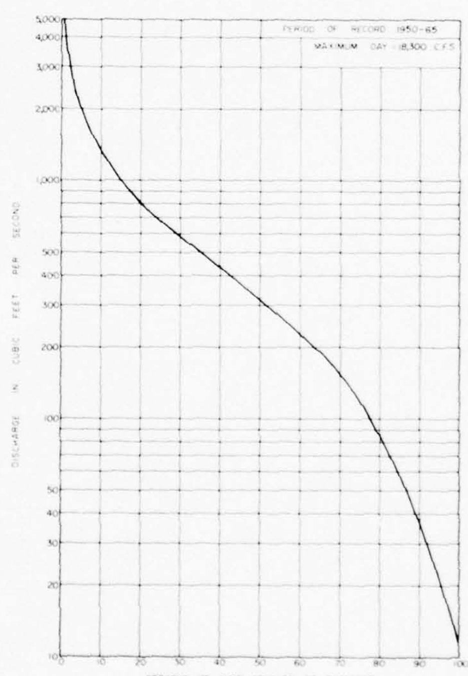


FIGURE 271 DURATION CURVE
7-3610 LITTLE MISSOURI RIVER NEAR MURFREESBORO, ARK.

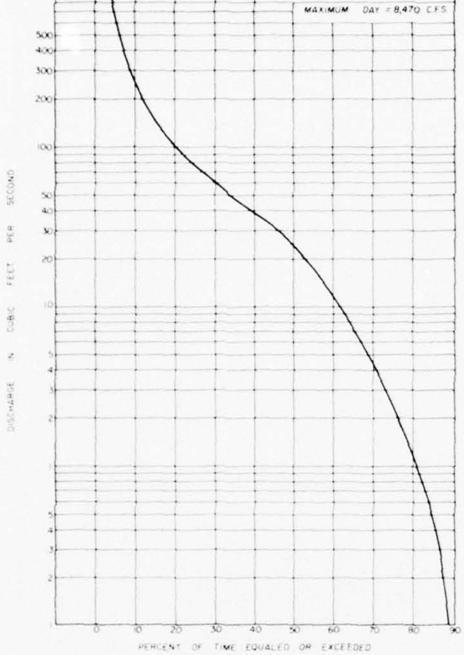


FIGURE 272 DURATION CURVE
7-3612 OZAN CREEK NEAR McCASKILL, ARK.

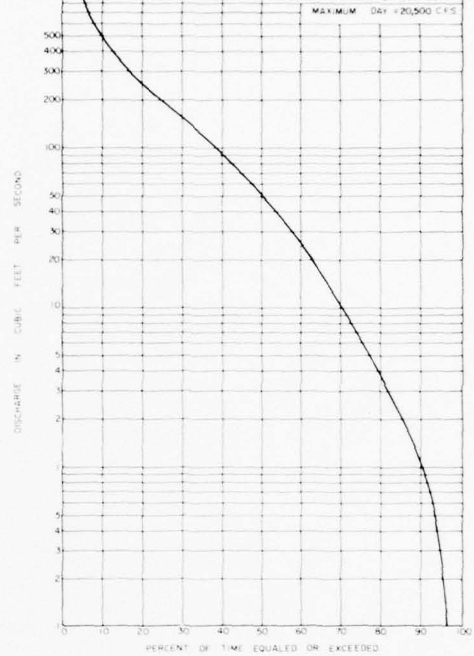


FIGURE 273 DURATION CURVE
7-3615 ANTOINE RIVER AT ANTOINE, ARK.

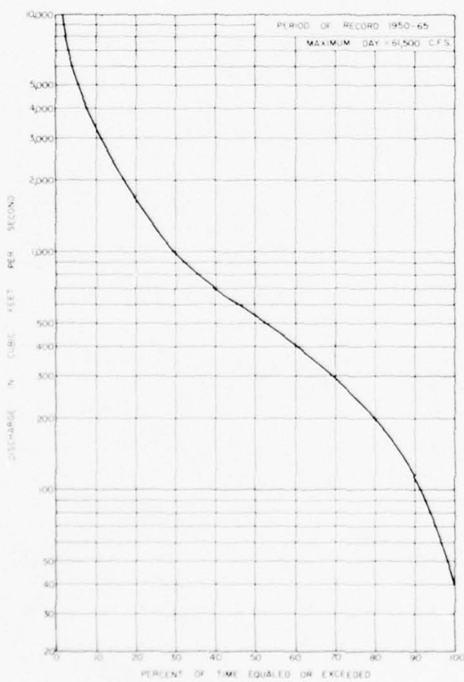


FIGURE 274 DURATION CURVE
7-3616 LITTLE MISSOURI RIVER NEAR BOUGHTON, ARK.

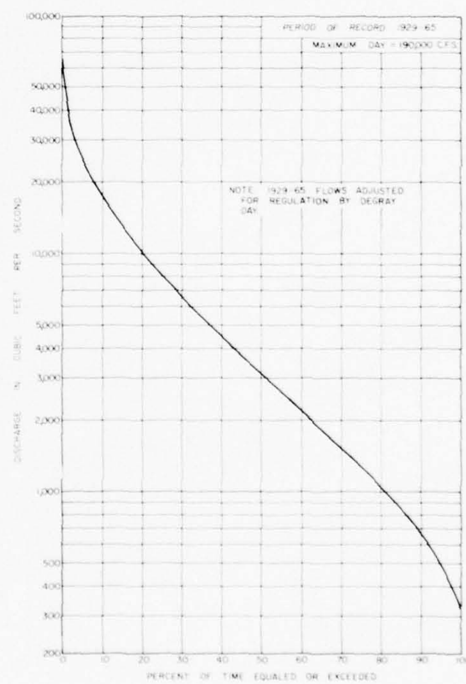


FIGURE 275 DURATION CURVE
7-3620 OUACHITA RIVER AT CAMDEN, ARK.

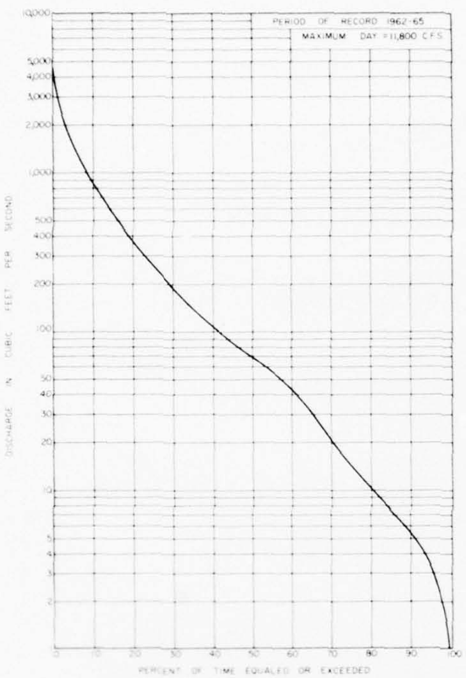


FIGURE 276 DURATION CURVE
7-3621 SMACKOVER CREEK NEAR SMACKOVER, ARK.

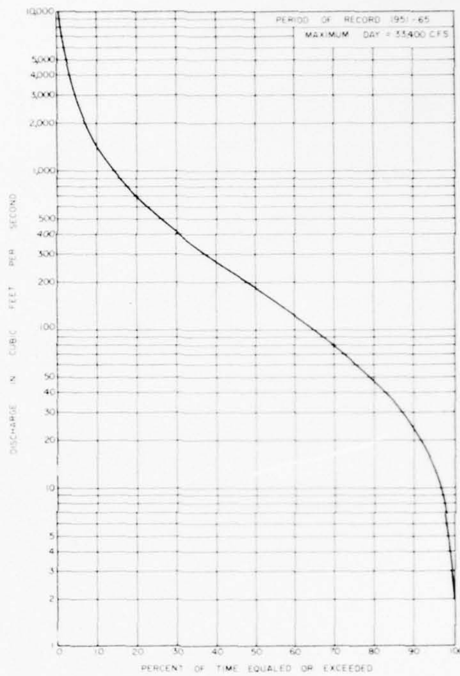


FIGURE 277 DURATION CURVE
7-3630 SALINE RIVER AT BENTON, ARK.

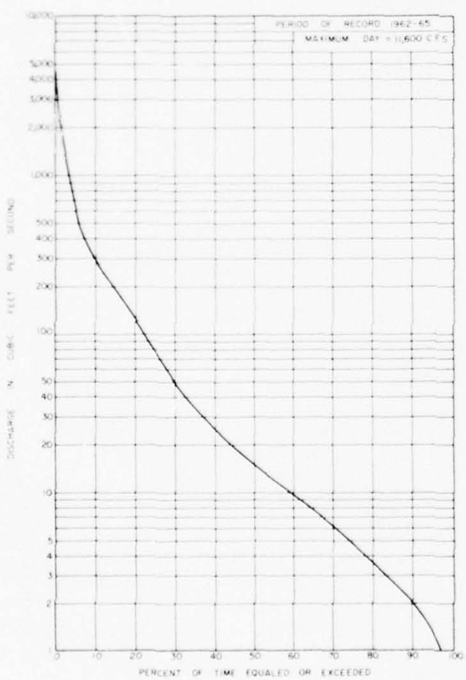


FIGURE 278 DURATION CURVE
7-3633 HURRICANE CREEK NEAR SHERIDON, ARK.

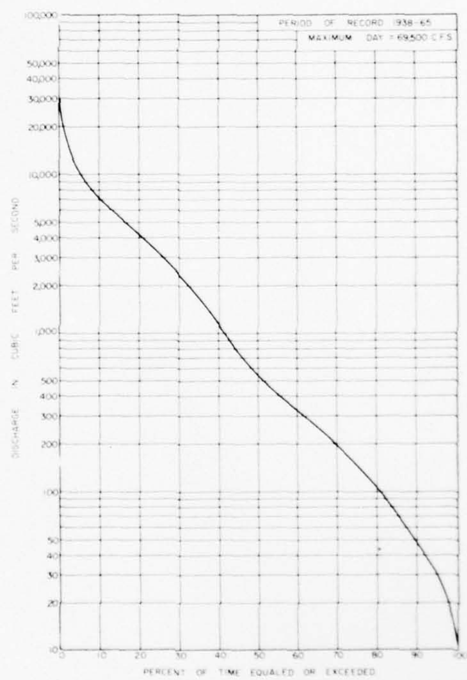


FIGURE 279 DURATION CURVE
7-3635 SALINE RIVER NEAR RYE, ARK.

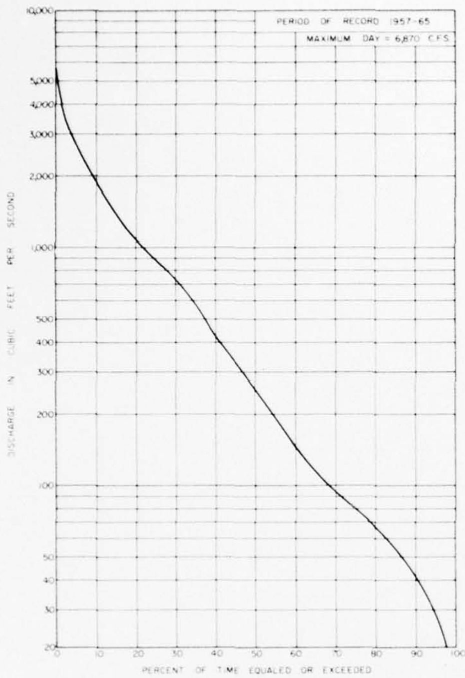


FIGURE 280 DURATION CURVE
7-36415 BAYOU BARTHOLOMEW NEAR McGEHEE, ARK.

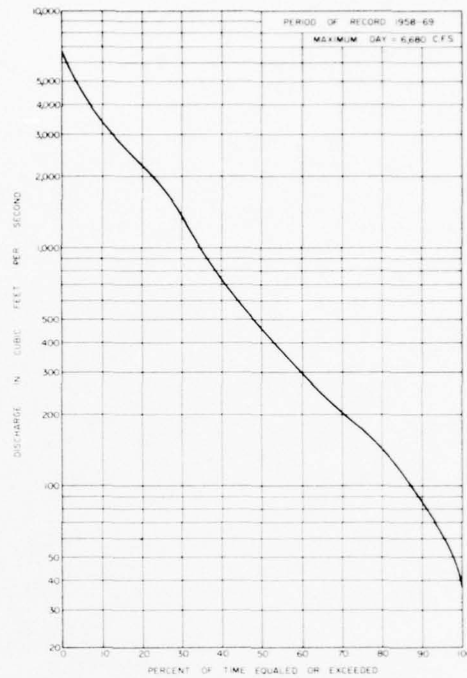


FIGURE 281 DURATION CURVE
7-3642 BAYOU BARTHOLOMEW NEAR JONES, LA.

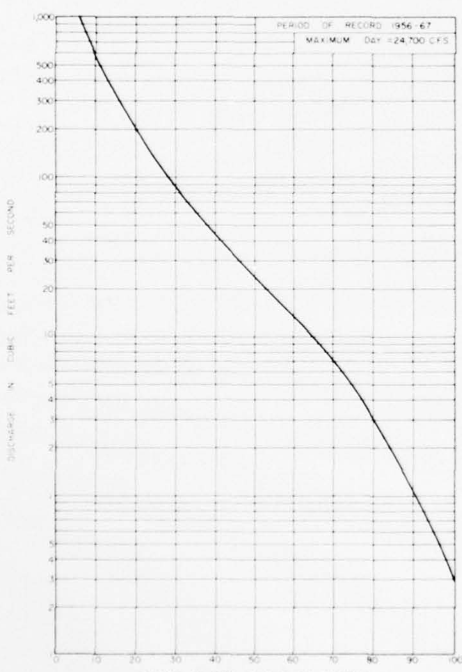


FIGURE 282 DURATION CURVE
7-3643 CHEMIN-A-HAUT BAYOU NEAR BEEKMAN, LA.

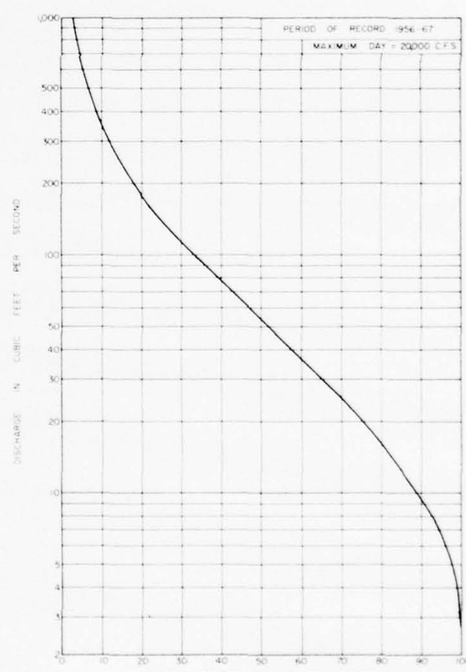


FIGURE 283 DURATION CURVE
7-3647 BAYOU DE LOUTRE NEAR LARAN, LA.

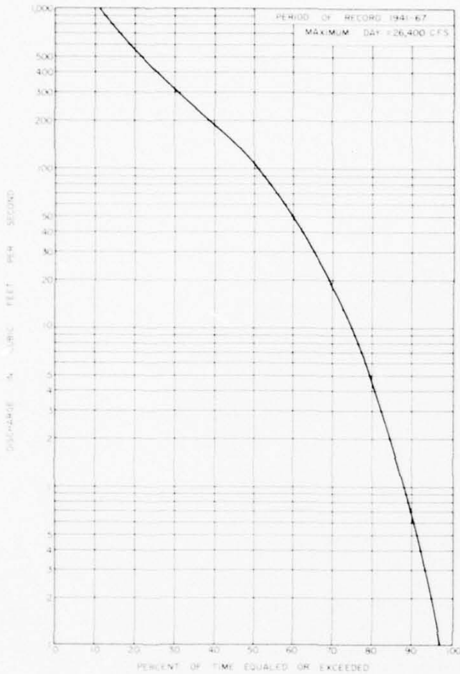


FIGURE 284 DURATION CURVE
7-3650 BAYOU D'ARBONNE NEAR DUBACH, LA.

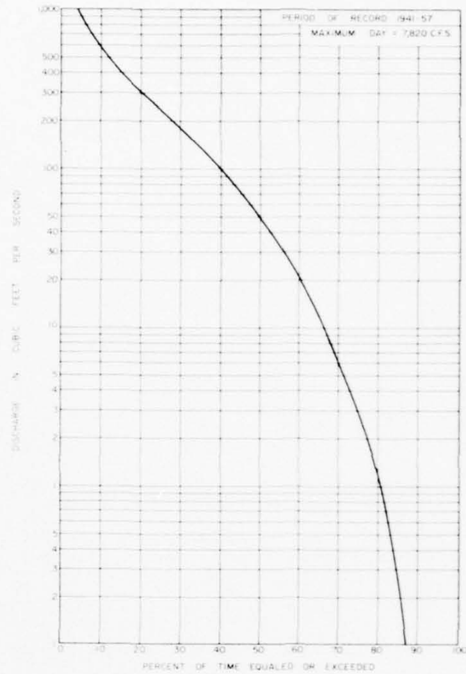


FIGURE 285 DURATION CURVE
7-3655 MIDDLE FORK BAYOU D'ARBONNE NEAR BERNICE, LA.

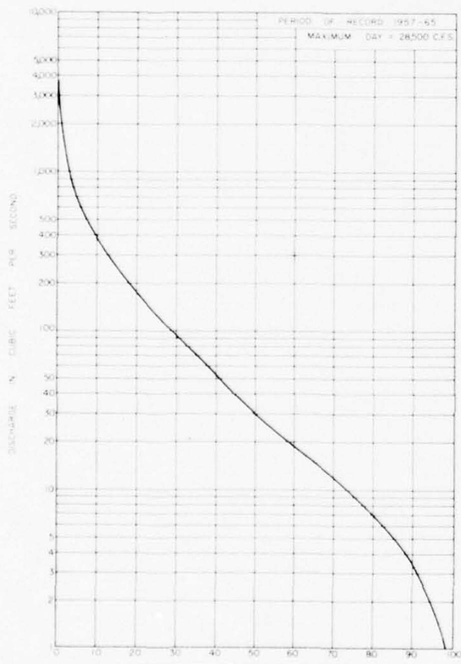


FIGURE 286 DURATION CURVE
7-3658 CORNIE BAYOU NEAR THREE CREEKS, ARK.

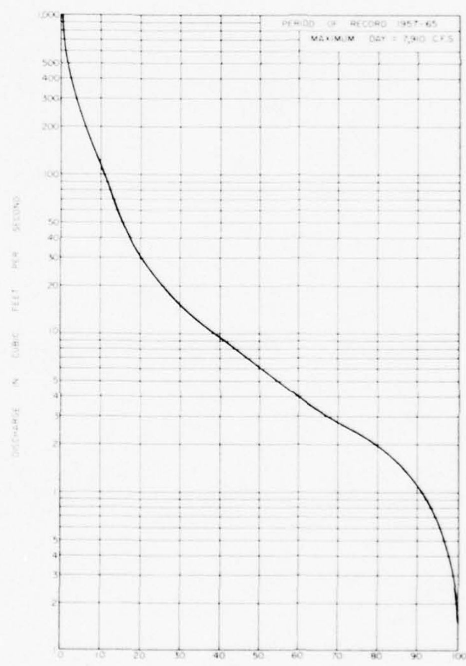


FIGURE 287 DURATION CURVE
7-3695 THREE CREEK NEAR THREE CREEKS, ARK.

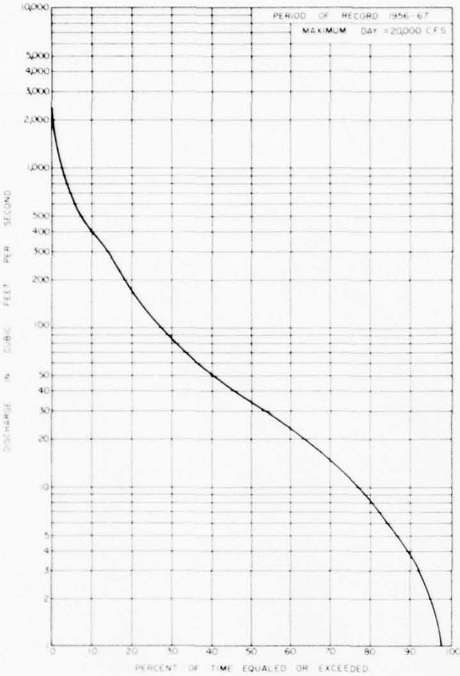


FIGURE 288 DURATION CURVE
7-3662 LITTLE CORNIE BAYOU NEAR LILLIE, LA.

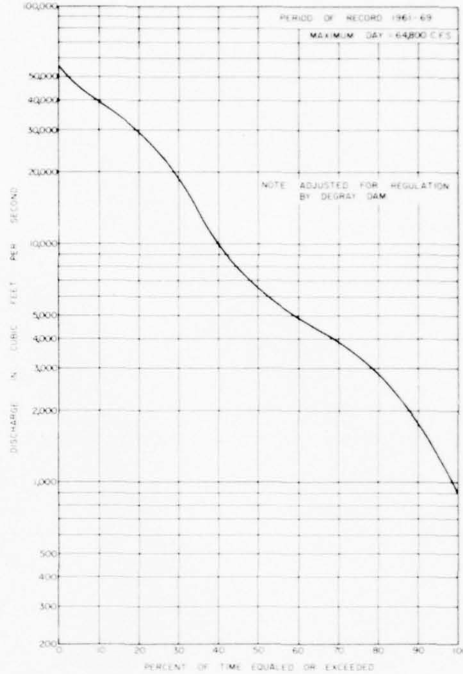


FIGURE 289 DURATION CURVE
7-3670 OUACHITA RIVER AT MONROE, LA.

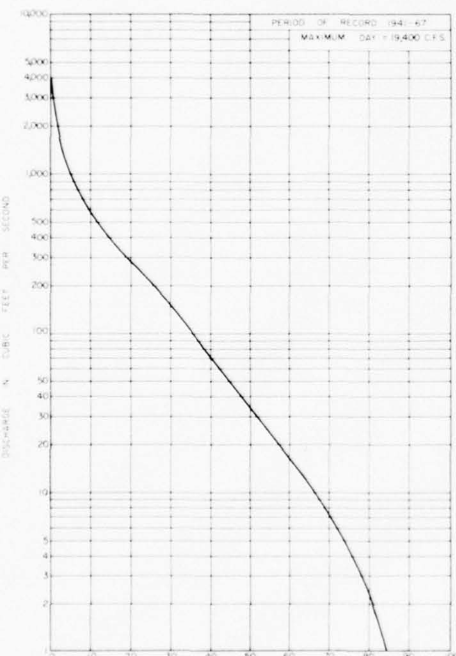


FIGURE 290 DURATION CURVE
7-3705 CASTOR CREEK NEAR GRAYSON, LA.

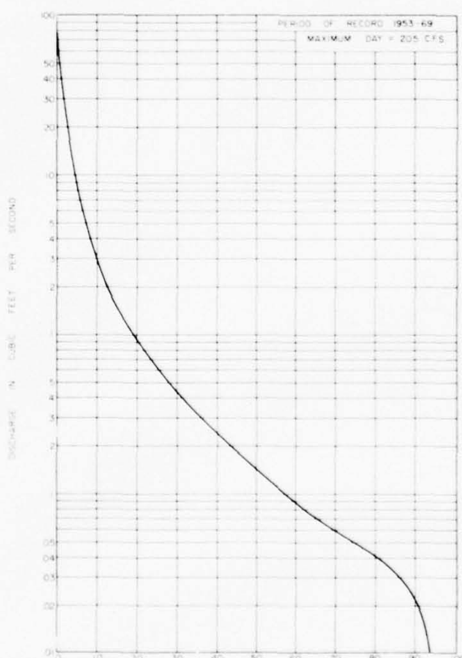


FIGURE 291 DURATION CURVE
7-3710 GARRETT CREEK AT JONESBORO, LA.

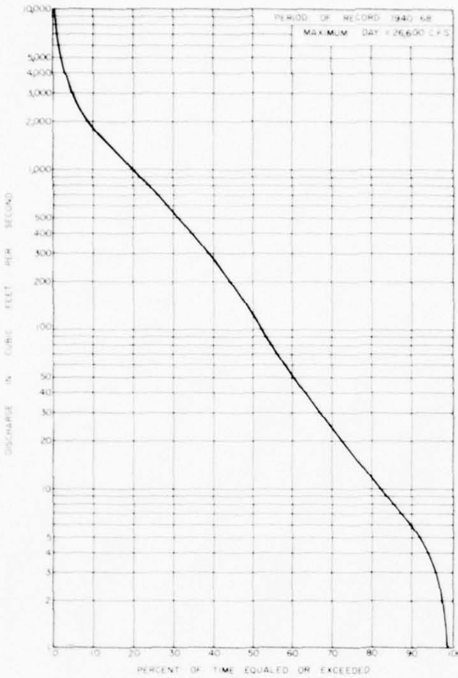


FIGURE 292 DURATION CURVE
7-3720 DUGDEMONA RIVER NEAR WINNFIELD, LA.

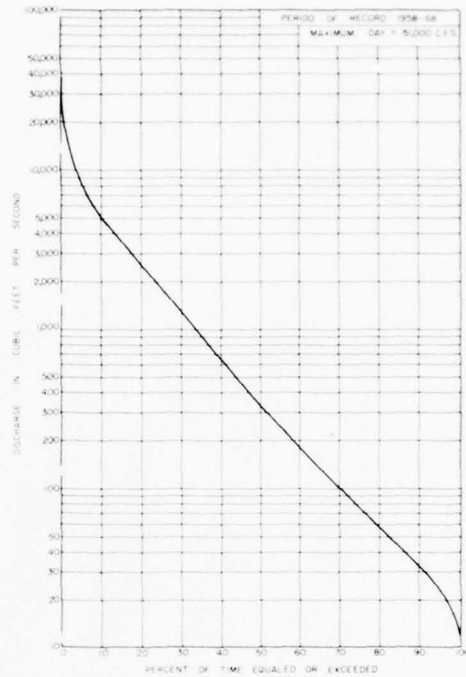


FIGURE 293 DURATION CURVE
7-3722 LITTLE RIVER NEAR ROCHELLE, LA.

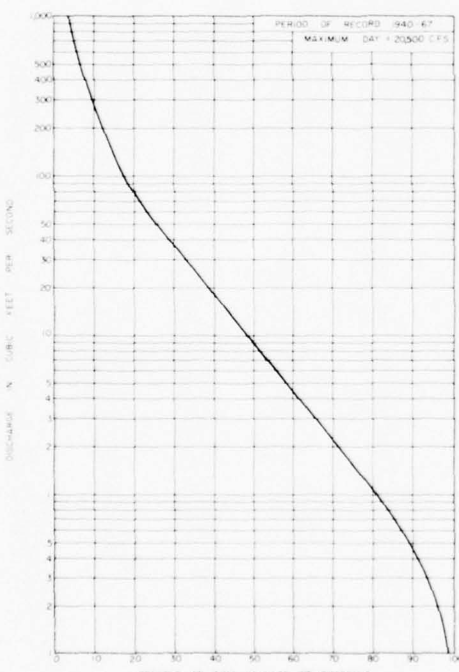


FIGURE 294 DURATION CURVE
7-3725 BAYOU FUNNY LOUIS NEAR TROUT, LA.

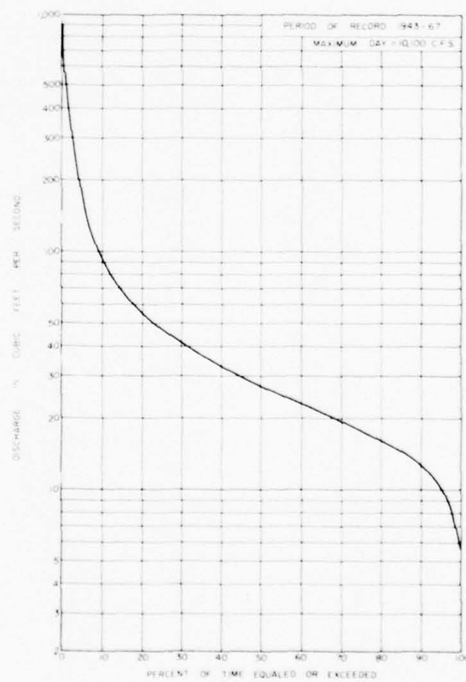


FIGURE 295 DURATION CURVE
7-3730 BIG CREEK AT POLLOCK, LA.

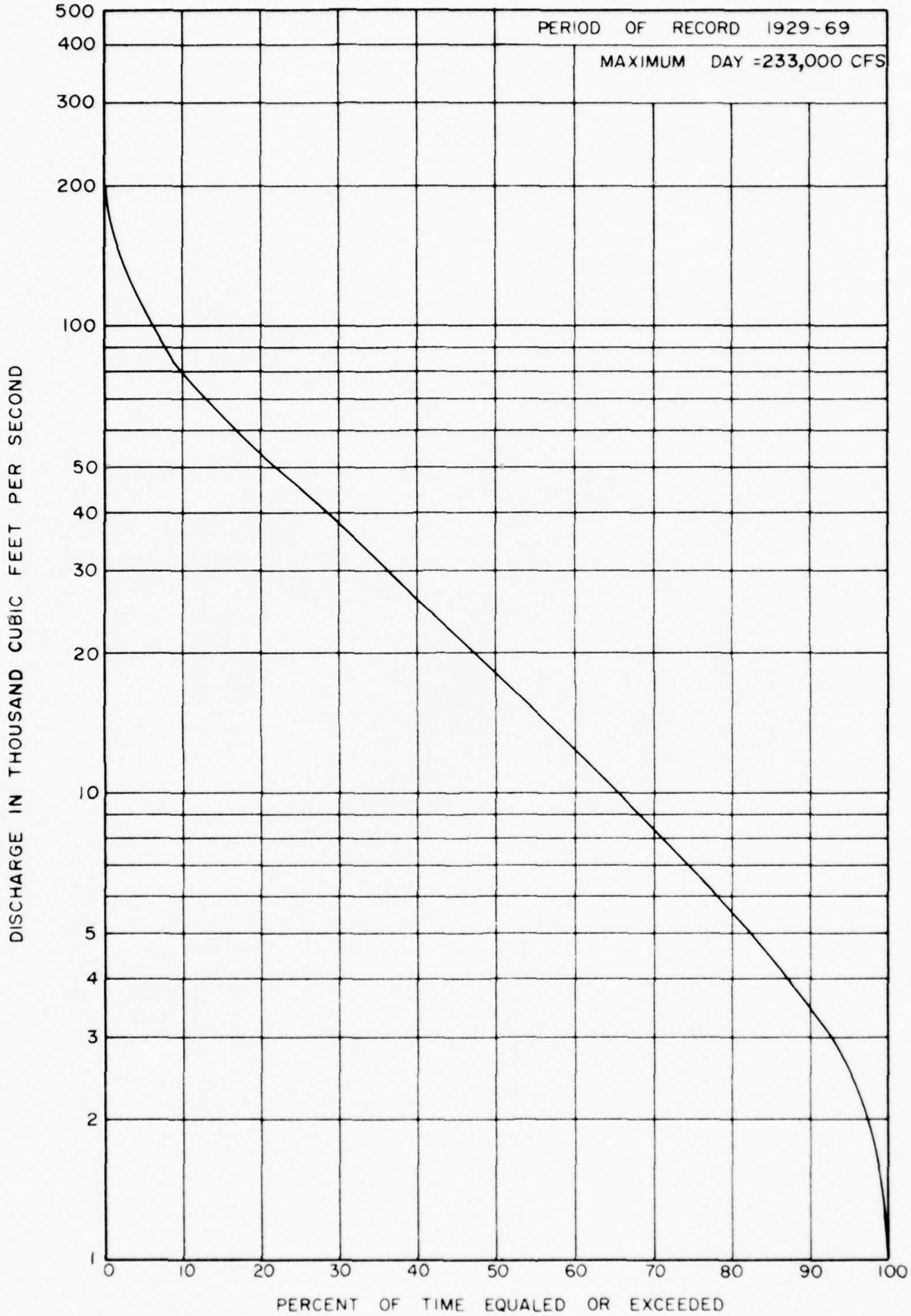


FIGURE 296
7-3555

DURATION CURVE
RED RIVER AT ALEXANDRIA, LA.

Table 161 - Dependable Yield at Sta 73560.00, Ouachita River near Mount Ida, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1942-1970 Mean
1	1963-1963	260	36.7
2	1963-1964	312	44.1
3	1963-1965	378	53.5
4	1963-1966	401	56.7
5	1963-1967	404	57.1
6	1962-1967	431	61.0
7	1961-1967	481	68.0
8	1960-1967	524	74.0
9	1959-1967	530	74.9
10	1958-1967	552	73.0
29	1942-1970	708	100.0

Table 162 - Dependable Yield at Sta 73565.00, South Fork Ouachita River at Mount Ida, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1950-1970 Mean
1	1954-1954	32	34.7
2	1954-1955	50	54.2
3	1954-1956	54	58.9
4	1963-1966	57	62.4
5	1963-1967	57	62.5
6	1962-1967	61	67.1
7	1961-1967	69	75.3
8	1960-1967	73	79.4
9	1959-1967	73	79.8
10	1958-1967	77	83.6
21	1950-1970	92	100.0

Table 163 - Dependable Yield at Sta 73575.01, Ouachita River at Blakely Mountain Dam, near Hot Springs, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1953-1970 Mean
1	1955-1955	305	23.2
2	1954-1955	366	27.8
3	1954-1956	515	39.1
4	1953-1956	603	45.8
5	1963-1967	946	71.8
6	1962-1967	1,031	78.3
7	1961-1967	1,143	86.8
8	1960-1967	1,210	91.9
9	1959-1967	1,237	93.9
10	1954-1963	1,300	98.7
18	1953-1970	1,317	100.0

Table 164 - Dependable Yield at Sta 73595.00, Ouachita River near Malvern, Ark., 1954-1969

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1954-1969 Mean
1	1954-1954	743	36.4
2	1954-1955	823	40.3
3	1954-1956	1,027	50.3
4	1963-1966	1,481	72.5
5	1963-1967	1,473	72.1
6	1962-1967	1,605	78.6
7	1961-1967	1,755	86.0
8	1960-1967	1,842	90.2
9	1959-1967	1,867	91.4
10	1958-1967	1,975	96.7
16	1954-1969	2,042	100.0

Table 165 - Dependable Yield at Sta 73598.00, Caddo River near Alpine, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1947-1970 Mean
1	1954-1954	197	37.6
2	1963-1964	320	61.0
3	1963-1965	319	61.0
4	1963-1966	333	63.6
5	1963-1967	350	66.8
6	1962-1967	382	72.9
7	1961-1967	424	81.0
8	1959-1966	428	81.7
9	1959-1967	427	81.4
10	1958-1967	459	87.7
24	1947-1970	524	100.0

Table 166 - Dependable Yield at Sta 73600.00, Ouachita River at Arkadelphia, Ark., 1954-1970

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1954-1970 Mean
1	1954-1954	1,133	36.9
2	1954-1955	1,464	47.7
3	1954-1956	1,670	54.4
4	1963-1966	2,408	78.5
5	1963-1967	2,450	79.8
6	1962-1967	2,627	85.6
7	1961-1967	2,820	91.9
8	1960-1967	2,894	94.3
9	1959-1967	2,896	94.4
10	1954-1963	2,984	97.3
17	1954-1970	3,068	100.0

Table 167 - Dependable Yield at Sta 73605.01, Little Missouri River at Narrows Dam, near Murfreesboro, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1951-1970 Mean
1	1954-1954	138	34.5
2	1963-1964	215	53.9
3	1963-1965	231	58.0
4	1963-1966	229	57.5
5	1963-1967	234	58.6
6	1962-1967	267	67.0
7	1961-1967	301	75.3
8	1960-1967	312	78.3
9	1959-1967	308	77.3
10	1958-1967	337	84.4
20	1951-1970	399	100.0

Table 168 - Dependable Yield at Sta 73610.00, Little Missouri River near Murfreesboro, Ark., 1952-1969

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1952-1969 Mean
1	1954-1954	203	35.0
2	1963-1964	324	56.0
3	1963-1965	334	57.7
4	1963-1966	330	57.1
5	1963-1967	346	59.7
6	1962-1967	398	68.7
7	1961-1967	444	76.7
8	1960-1967	462	79.9
9	1959-1967	458	79.1
10	1959-1968	508	87.7
18	1952-1969	579	100.0

Table 169 - Dependable Yield at Sta 73615.00, Antoine River at Antoine, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1955-1969 Mean
1	1963-1963	133	54.7
2	1965-1966	160	65.9
3	1963-1965	157	64.6
4	1963-1966	160	65.9
5	1963-1967	169	69.4
6	1962-1967	186	76.7
7	1961-1967	203	83.5
8	1959-1966	202	83.1
9	1959-1967	202	83.1
10	1959-1968	218	89.7
15	1955-1969	243	100.0

Table 170 - Dependable Yield at Sta 73616.00, Little Missouri River near Boughton, Ark., 1952-1970

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1952-1970 Mean
1	1954-1954	509	37.0
2	1963-1964	791	57.4
3	1963-1965	808	58.7
4	1963-1966	822	59.7
5	1963-1967	851	61.8
6	1962-1967	1,008	73.2
7	1961-1967	1,101	79.9
8	1960-1967	1,137	82.5
9	1959-1967	1,129	82.0
10	1959-1968	1,238	89.9
19	1952-1970	1,377	100.0

Table 171 - Dependable Yield at Sta 73620.00, Ouachita River at Camden, Ark., 1953-1970

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1953-1970 Mean
1	1954-1954	2,390	36.0
2	1954-1955	3,394	51.1
3	1954-1956	3,527	53.1
4	1963-1966	4,662	70.2
5	1963-1967	4,662	70.2
6	1962-1967	5,338	80.4
7	1961-1967	5,707	86.0
8	1960-1967	5,867	88.4
9	1959-1967	5,846	88.1
10	1959-1968	6,368	95.9
18	1953-1970	6,638	100.0

Table 172 - Dependable Yield at Sta 73630.00, Saline River at Benton, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1951-1969 Mean
1	1963-1963	280	38.1
2	1954-1955	442	60.2
3	1963-1965	468	63.6
4	1963-1966	508	69.2
5	1963-1967	519	70.7
6	1962-1967	563	76.6
7	1961-1967	583	79.3
8	1960-1967	608	82.7
9	1959-1967	619	84.2
10	1959-1968	663	90.2
19	1951-1969	735	100.0

Table 173 - Dependable Yield at Sta 73635.00, Saline River near Rye, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1938-1969 Mean
1	1940-1940	758	29.7
2	1954-1955	1,096	42.9
3	1954-1956	1,291	50.6
4	1963-1966	1,471	57.6
5	1963-1967	1,495	58.6
6	1962-1967	1,742	68.2
7	1961-1967	1,849	72.4
8	1960-1967	1,932	75.7
9	1959-1967	1,938	75.9
10	1959-1968	2,101	82.3
32	1938-1969	2,553	100.0

Table 174 - Dependable Yield at Sta 73641.50, Bayou Bartholomew near McGehee, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1957-1969 Mean
1	1963-1963	195	30.8
2	1963-1964	314	49.7
3	1963-1965	387	61.3
4	1963-1966	397	62.9
5	1963-1967	377	59.7
6	1962-1967	443	70.1
7	1963-1969	471	74.5
8	1960-1967	494	78.1
9	1959-1967	504	79.8
10	1960-1969	536	84.8
13	1957-1969	632	100.0

Table 175 - Dependable Yield at Sta 73642.00, Bayou Bartholomew near Jones, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1958-1969 Mean
1	1963-1963	323	27.5
2	1966-1967	576	49.1
3	1965-1967	652	55.6
4	1963-1966	663	56.5
5	1963-1967	622	53.0
6	1963-1968	768	65.5
7	1963-1969	843	71.9
8	1960-1967	918	78.3
9	1959-1967	971	82.8
10	1960-1969	1,014	86.4
12	1958-1969	1,173	100.0

Table 176 - Dependable Yield at Sta 73643.00, Chemin-A-Haut Bayou near Beekman, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1956-1969 Mean
1	1963-1963	22	8.8
2	1963-1964	56	22.5
3	1963-1965	73	29.5
4	1963-1966	90	36.4
5	1963-1967	96	38.8
6	1962-1967	137	55.4
7	1963-1969	157	63.4
8	1960-1967	159	64.3
9	1959-1967	163	65.5
10	1959-1968	182	73.3
14	1956-1969	248	100.0

Table 177 - Dependable Yield at Sta 73647.00, Bayou De L'Outre near Laran, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1956-1968 Mean
1	1963-1963	76	45.6
2	1963-1964	81	48.6
3	1963-1965	85	51.2
4	1963-1966	89	53.4
5	1963-1967	86	52.0
6	1963-1968	104	62.7
7	1962-1968	124	74.5
8	1960-1967	132	79.5
9	1959-1967	138	83.2
10	1959-1968	144	86.5
13	1956-1968	166	100.0

Table 178 - Dependable Yield at Sta 73650.00, Bayou D'Arbonne near Dubach, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1941-1968 Mean
1	1963-1963	57	14.0
2	1963-1964	87	21.3
3	1963-1965	114	28.1
4	1963-1966	146	35.8
5	1963-1967	136	33.5
6	1963-1968	168	41.4
7	1962-1968	225	55.3
8	1960-1967	253	62.2
9	1960-1968	261	64.2
10	1959-1968	284	69.8
28	1941-1968	407	100.0

Table 179 - Dependable Yield at Sta 73655.00, Middle Fork Bayou D'Arbonne near Bernice, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1941-1957 Mean
1	1943-1943	68	30.3
2	1954-1955	94	42.1
3	1954-1956	99	44.3
4	1954-1957	127	56.9
5	1953-1957	153	68.5
6	1951-1956	164	73.1
7	1951-1957	171	76.2
8	1949-1956	190	85.1
9	1948-1956	190	84.7
10	1948-1957	192	85.7
17	1941-1957	224	100.0

Table 180 - Dependable Yield at Sta 73658.00, Cornie Bayou near Three Creeks, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1957-1968 Mean
1	1967-1967	31	19.6
2	1963-1964	56	35.4
3	1963-1965	74	47.3
4	1964-1967	83	52.5
5	1963-1967	74	47.1
6	1963-1968	88	56.0
7	1961-1967	124	78.8
8	1960-1967	122	77.8
9	1959-1967	120	76.4
10	1959-1968	124	78.8
12	1957-1968	158	100.0

Table 181 - Dependable Yield at Sta 73659.00, Three Creek near Three Creeks, Ark.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1957-1969 Mean
1	1967-1967	12	23.0
2	1966-1967	20	38.3
3	1965-1967	22	43.4
4	1964-1967	23	45.0
5	1963-1967	22	42.1
6	1963-1968	30	57.4
7	1963-1969	35	68.1
8	1960-1967	38	74.4
9	1959-1967	38	74.0
10	1959-1968	41	80.0
13	1957-1969	52	100.0

Table 182 - Dependable Yield at Sta 73662.00, Little Cornie Bayou near Lillie, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1956-1968 Mean
1	1967-1967	52	31.5
2	1966-1967	66	40.3
3	1965-1967	70	42.4
4	1964-1967	73	44.3
5	1963-1967	69	41.8
6	1963-1968	91	55.6
7	1962-1968	116	70.8
8	1960-1967	122	74.4
9	1959-1967	129	78.6
10	1959-1968	137	83.2
13	1956-1968	164	100.0

Table 183 - Dependable Yield at Sta 73670.00, Ouachita River at Monroe, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1951-1969 Mean
1	1963-1963	5,822	37.2
2	1963-1964	7,595	48.6
3	1963-1965	8,672	55.5
4	1963-1966	9,333	59.7
5	1963-1967	9,156	58.6
6	1962-1967	11,348	72.6
7	1963-1969	12,451	79.6
8	1960-1967	12,692	81.2
9	1959-1967	12,954	82.8
10	1959-1968	14,038	89.8
19	1951-1969	15,637	100.0

Table 184 - Dependable Yield at Sta 73705.00, Castor Creek near Grayson, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1941-1968 Mean
1	1963-1963	23	9.2
2	1963-1964	59	23.7
3	1963-1965	93	37.3
4	1963-1966	138	55.5
5	1963-1967	125	50.4
6	1963-1968	153	61.5
7	1959-1965	174	70.2
8	1960-1967	182	73.4
9	1959-1967	174	70.1
10	1959-1968	186	74.8
28	1941-1968	249	100.0

Table 185 - Dependable Yield at Sta 73710.00, Garrett Creek at Jonesboro, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1953-1969 Mean
1	1967-1967	0	0.0
2	1966-1967	0	22.1
3	1965-1967	0	29.4
4	1964-1967	0	33.1
5	1963-1967	0	26.5
6	1963-1968	0	36.8
7	1963-1969	0	37.8
8	1962-1969	1	49.7
9	1961-1969	1	54.0
10	1960-1969	1	53.0
17	1953-1969	2	100.0

Table 186 - Dependable Yield at Sta 73720.00, Dugdemona River near Winnfield, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1940-1968 Mean
1	1963-1963	63	8.8
2	1963-1964	140	19.6
3	1963-1965	164	23.0
4	1963-1966	268	37.5
5	1963-1967	249	34.8
6	1963-1968	356	49.9
7	1961-1967	433	60.6
8	1960-1967	433	60.6
9	1959-1967	451	63.1
10	1959-1968	496	69.3
29	1940-1968	715	100.0

Table 187 - Dependable Yield at Sta 73722.00, Little River near Rochelle, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1958-1968 Mean
1	1963-1963	262	14.3
2	1963-1964	575	31.4
3	1963-1965	756	41.3
4	1963-1966	1,047	57.2
5	1963-1967	989	54.0
6	1963-1968	1,260	68.8
7	1962-1968	1,464	79.9
8	1960-1967	1,457	79.5
9	1959-1967	1,453	79.3
10	1959-1968	1,569	85.7
11	1958-1968	1,832	100.0

Table 188 - Dependable Yield at Sta 73725.00, Bayou Funny Louis near Trout, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1940-1968 Mean
1	1963-1963	30	23.5
2	1963-1964	55	43.1
3	1954-1956	67	52.4
4	1954-1957	86	67.3
5	1963-1967	84	65.8
6	1963-1968	97	76.2
7	1954-1960	96	75.6
8	1959-1966	107	84.4
9	1959-1967	103	81.0
10	1954-1963	107	84.2
29	1940-1968	127	100.0

Table 189 - Dependable Yield at Sta 73730.00, Big Creek at Pollock, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow 1,000 c.f.s.	Percent of 1943-1968 Mean
1	1956-1956	23	37.0
2	1963-1964	27	44.2
3	1954-1956	31	49.9
4	1954-1957	34	54.7
5	1963-1967	41	66.6
6	1963-1968	44	71.1
7	1954-1960	44	71.0
8	1960-1967	49	79.6
9	1959-1967	48	77.9
10	1955-1964	47	77.1
26	1943-1968	62	100.0

Table 190 - Dependable Yield at Sta 73555.00, Red River at Alexandria, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1929-1970 Mean
1	1936-1936	11,050	30.6
2	1963-1964	12,580	34.8
3	1963-1965	14,646	40.6
4	1963-1966	16,492	45.7
5	1963-1967	16,920	46.9
6	1962-1967	19,845	55.0
7	1961-1967	21,994	60.9
8	1960-1967	22,596	62.6
9	1959-1967	22,165	61.4
10	1959-1968	24,371	67.5
42	1929-1970	31,020	100.0

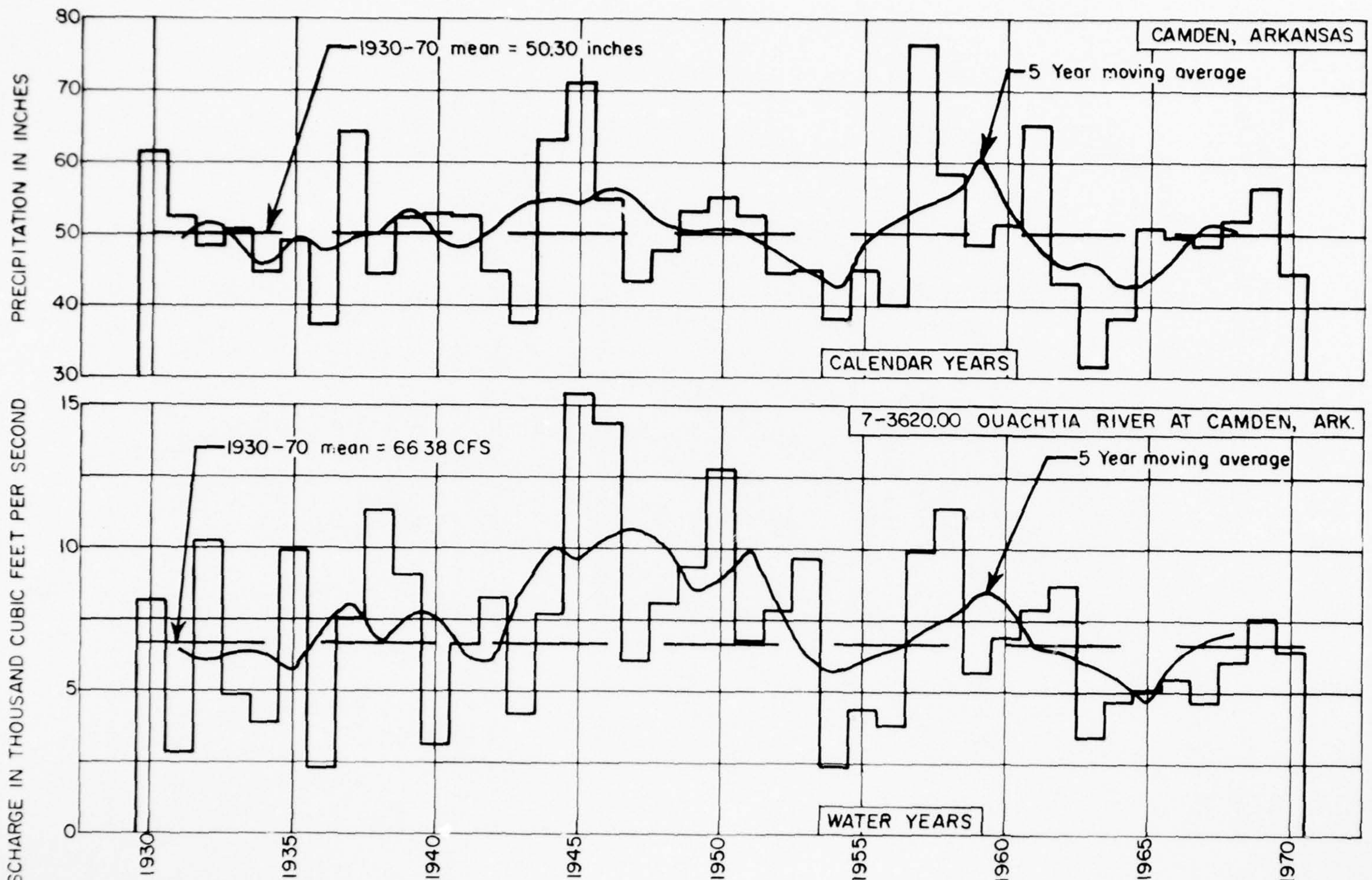


FIGURE 297 LONG-TERM VARIATION IN PRECIPITATION AND STREAMFLOW

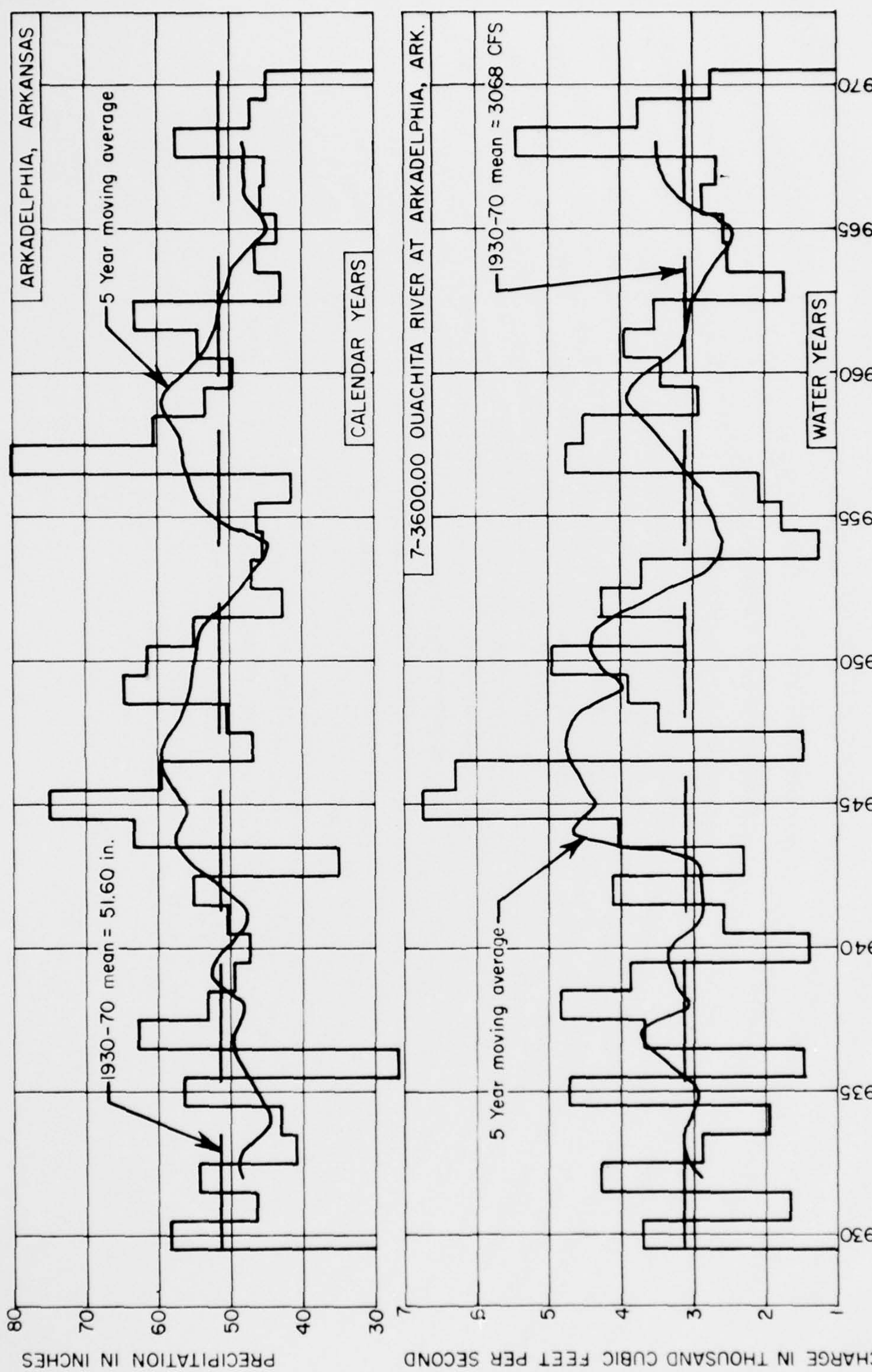


FIGURE 298 LONG-TERM VARIATION IN PRECIPITATION AND STREAMFLOW

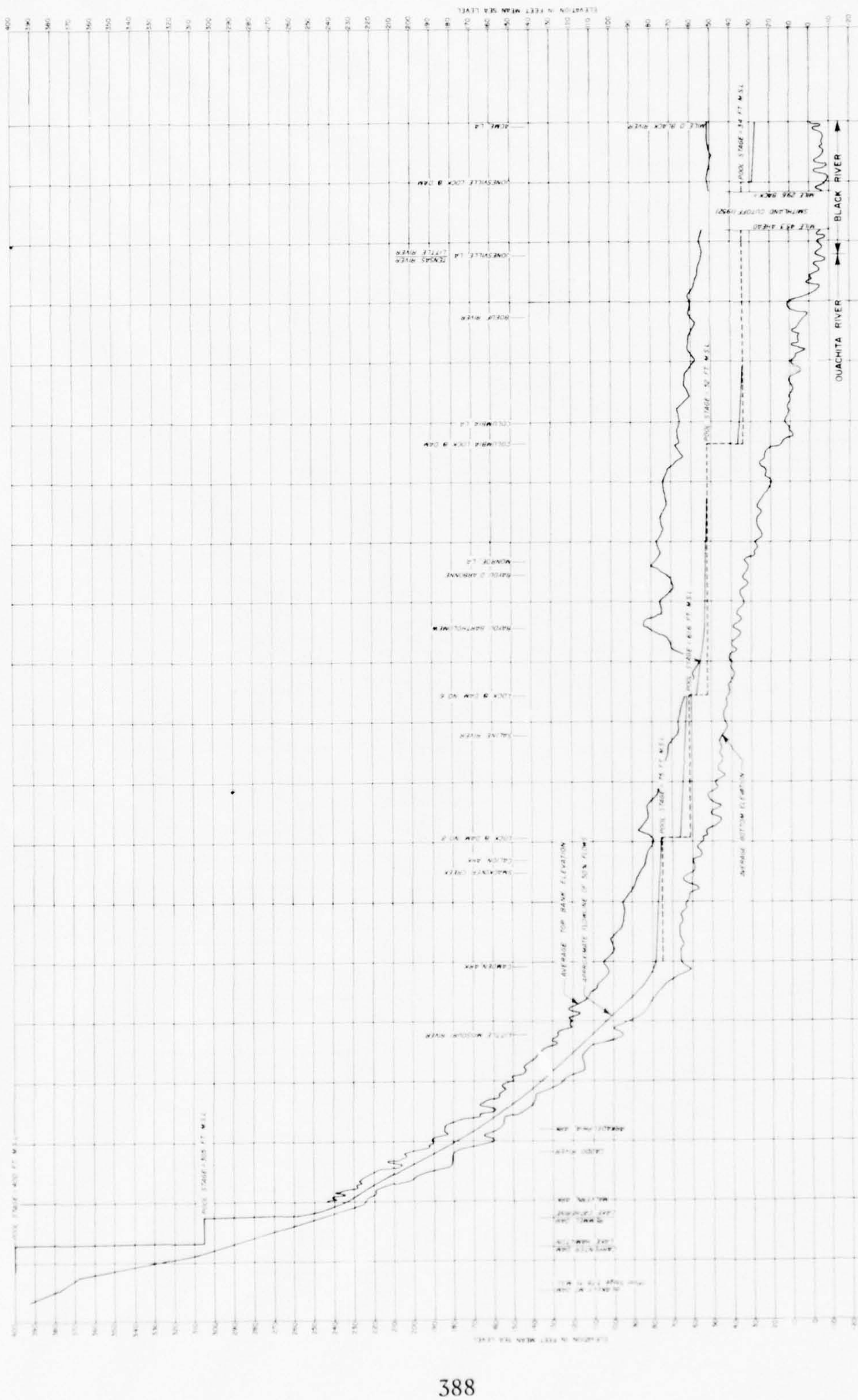


FIGURE [illegible] STREAM PROFILE, QUACHITA AND BLACK RIVERS, ARKANSAS AND LOUISIANA

Table 191 - Chemical Analyses of Water from Streams in WRPA 5 in the Lower Mississippi Region, Milligrams Per Liter

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
						07361200 Ozan Creek near McCaskill, Ark. (drainage area, 148 sq mi)													
Tokio Formation and alluvium	9- 8-60	0.27	0.7	0.00	17	0.8	2.0	1.6	51	6.0	3.0	0.0	0.1	56	46	4	101	6.8	6
	8-15-62	.14	5.5	.01	28	1.7	2.0	1.8	84	5.4	5.0	.2	.5	91	77	8	165	6.4	10
						07336900 Walnut Bayou near Foreman, Ark. (drainage area, 83.6 sq mi)													
Ozan Formation and alluvium	9-23-60	0.21	6.5	0.00	124	30	145	5.2	336	167	210	0.5	0.6	855	433	158	1,480	6.9	5
	8-16-62	.10	9.8	.00	91	19	147	3.6	273	117	205	.1	.2	727	305	82	1,260	8.1	4
						07336950 Barkman Creek near Leary, Tex. (drainage area, 31.5 sq mi)													
Midway Group	5-23-61	2.3	5.7	0.00	6.4	2.4	11	2.1	35	3.8	9.0	0.3	1.0	59	26	0	108	6.2	45
	9-18-62	.90	12	.03	7.2	1.8	13	2.6	36	6.8	10	2.0	.2	74	25	0	129	6.3	30
						07363100 Francois Creek near Poyen, Ark. (drainage area, 84.1 sq mi)													
Wilcox Group and lower part of Claiborne Group	9-20-60	0.05	1.6	--	6.4	1.3	9.0	2.0	16	23	3.0	0.1	0.3	54	22	8	109	6.3	7
	6-27-61	5.2	5.9	--	6.4	1.9	9.4	1.1	10	36	1.0	.0	.6	67	24	16	107	6.4	5
						07361700 Caney Creek near Bluff City, Ark. (drainage area, 167 sq mi)													
Wilcox Group, Carrizo Sand, and Sparta Sand	9- 8-60	0.66	0.8	0.00	58	16	580	9.5	30	18	1,040	0.9	0.7	1,740	210	186	3,400	6.5	7
	8-15-62	.30	2.9	.00	69	19	561	12	2	14	1,050	.3	.4	1,730	250	249	3,350	5.4	4
						07344100 Caney Creek near Redwater, Tex. (drainage area, 18 sq mi)													
Wilcox Formation and alluvium	5-23-61	3.9	17	0.00	5.2	3.0	13	1.2	40	4.0	12	0.2	0.9	76	26	0	113	6.5	40
	9-18-62	.57	22	.03	9.0	2.9	9.4	1.9	45	5.4	10	.2	.0	83	34	0	114	6.3	15
						07360100 L'Eau Frais Creek at Joan, Ark. (drainage area, 79.4 sq mi)													
Lower part of Claiborne Group	9- 6-60	2.7	0.5	0.00	1.7	0.5	1.3	0.8	7	1.2	2.0	0.3	0.6	12	6	0	23	6.3	15
	8-13-62	3.9	6.3	.04	1.9	.6	1.7	1.0	6	2.8	3.0	.2	.6	21	7	2	26	6.4	5
						07346020 Kelly Creek near Marietta, Tex. (drainage area, 50.5 sq mi)													
Carrizo Sand and Reklaw and Queen City Sand Members of Mount Selman Formation	5-23-61	6.2	14	0.00	2.9	1.6	3.7	1.3	12	5.6	3.5	0.2	2.6	41	14	4	49	6.1	15
	9-18-62	.39	29	.01	6.2	2.5	4.9	2.8	2	28	6.0	.1	.0	81	26	24	93	5.4	5

Table 191 - Chemical Analyses of Water from Streams in WRPA 5 in the Lower Mississippi Region, Milligrams Per Liter--Continued

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
07346320 Black Bayou near Atlanta, Tex. (drainage area, 52.1 sq mi)																			
Queen City Sand and Weches Greensand Members of Mount Selman Formation and Sparta Sand	5-23-61 9-18-62	8.1 4.9	10 19	0.00 .05	3.0 4.2	1.0 1.8	19 31	1.7 2.9	36 53	3.8 3.4	15 27	0.3 .2	2.9 4.0	76 120	16 18	0 0	121 189	6.7 6.2	30 25
07361900 Bayou Freeo near Eagle Mills, Ark. (drainage area, 94.8 sq mi)																			
Sparta Sand and terrace deposits	9- 6-60 8-13-62	1.7 .43	5.0 14	0.00 .22	4.9 4.5	0.7 2.4	3.7 5.3	1.8 2.4	18 30	3.2 4.8	3.8 3.2	0.0 .3	0.3 .6	32 52	15 21	0 0	51 75	6.7 7.1	6 30
07361850 Tulip Creek near Pine Grove Ark. (drainage area, 152 sq mi)																			
Sparta Sand and alluvium	9- 6-60 8-13-62	2.6 4.2	5.7 7.3	0.06 .02	3.2 3.2	0.5 1.0	1.4 2.2	1.1 1.4	12 14	2.6 3.2	1.8 2.2	0.1 .3	0.8 .3	23 28	10 12	0 0	31 37	6.4 6.6	20 10
07364250 Chemin-a-Haut Creek near Berlin, Ark. (drainage area, 216 sq mi)																			
Terrace deposits and alluvium	9-20-60 8-13-62	4.1 1.6	4.5 4.9	0.00 .02	30 25	7.0 8.6	22 20	3.6 3.8	146 139	2.6 4.2	21 20	0.2 .2	0.6 .8	164 156	104 98	0 0	278 278	7.3 7.8	20 10

Table 191 - Chemical Analyses of Water from Streams in WRPA 5 in the Lower Mississippi Region, Milligrams Per Liter--Continued

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
	07365100 Cypress Creek near Unionville, La. (drainage area, 63.3 sq mi)																		
Cook Mountain Formation	11-18-60	0.20	1.4	0.58	5.1	1.9	27	4.8	50	22	14	0.3	1.7	104	20	0	177	6.8	65
	8-17-62	.53	11	.03	5.2	2.6	43	3.8	72	15	32	.4	.2	128	24	0	253	6.2	10
	12- 8-70	12	18	.11	6.7	1.8	23	4.0	58	8.4	14	.1	.4	114	24	0	177	7.2	10
	07364900 Big Creek near Vienna, La. (drainage area, 68.9 sq mi)																		
	10-18-60	0.19	1.8	1.2	3.6	0.9	2.5	2.2	11	7.2	2.8	0.1	1.7	29	12	4	43	6.7	250
	4-19-63	11	5.4	.14	4.9	1.8	3.3	1.6	16	8.0	5.8	.0	.6	39	20	6	62	6.8	45
	07364800 Bayou D'Arbonne at Homer, La. (drainage area, 30 sq mi)																		
	10-13-60	1.6	4.2	0.24	2.2	1.1	3.8	2.2	11	4.8	4.8	0.1	0.9	30	10	0	46	6.5	60
	9-21-62	1.5	19	.06	1.5	1.4	3.0	1.7	8	2.4	6.1	.1	.5	40	10	3	38	5.4	25
	07365300 Middle Fork Bayou D'Arbonne near Colquitt, La. (drainage area, 43.9 sq mi)																		
	10-13-60	0.87	6.4	0.00	26	6.5	58	5.0	14	9.2	122	0.2	1.3	262	92	80	527	6.0	10
	9-21-62	3.7	18	.10	15	4.1	46	2.8	10	6.6	103	.2	.0	200	54	46	369	5.7	5
	07364750 Bayou de Loutre at De Loutre, La. (drainage area, 302 sq mi)																		
Cook Mountain and Cockfield Formations	11- 4-60	34	1.4	0.00	307	42	939	33	68	55	2,050	0.9	0.3	3,460	938	883	6,330	6.6	22
	8-14-62	10	7.3	.01	249	34	866	16	47	66	1,830	1.0	1.5	3,090	762	723	5,660	6.5	15
	07365850 Little Corney Bayou near Summerfield, La. (drainage area, 54 sq mi)																		
Cockfield Formation	11-17-60	6.2	7.3	0.04	12	2.3	22	3.2	10	5.2	54	0.2	0.8	112	40	32	213	6.6	25
	8-15-62	.17	16	.09	13	2.6	12	2.4	34	2.6	29	.1	.0	95	43	15	164	6.0	10
	07367300 North Cheniere Creek at Cheniere, La. (drainage area, 38 sq mi)																		
Cockfield Formation and alluvium	10-11-60	4.5	7.1	0.13	5.6	0.1	8.3	1.5	9	4.4	16	0.2	0.8	48	14	7	112	6.5	40
	8-14-62	2.3	15	.01	2.5	1.4	3.0	1.5	11	.2	7.0	.1	1.0	37	12	3	41	5.5	10
	07370820 Dugdemona River near Quitman, La. (drainage area, 117 sq mi)																		
Sparta Sand	11-13-60	3.5	5.0	1.2	3.2	0.7	3.8	2.1	14	4.2	2.8	0.2	1.4	31	11	0	40	6.3	150
	8-15-62	.28	20	.65	7.2	3.4	5.7	2.6	41	3.5	7.1	.1	.2	69	32	0	92	6.0	25

GROUND WATER

Paleozoic, Cretaceous, Tertiary, and Quaternary aquifers contain fresh water in WRPA 5 (figure 300). The Paleozoic rocks form the mountainous region in the northern one-sixth of the area; they are overlain to the south by south and southeasterly dipping Cretaceous and Tertiary beds. Quaternary alluvium underlies major floodplains, and alluvial and terrace deposits blanket much of the northeastern part of the area.

Pumpage from the Sparta Sand and the Quaternary aquifer accounts for about 85 percent of the ground water pumped in the area (about 220 mgd). Almost all of the remainder comes from six additional aquifers, the Paleozoic rocks, Tokio Formation, Nacatoch Sand, Wilcox Group, Cockfield Formation, and Miocene deposits. Seven more aquifers may be considered minor, as they supply only about 2 mgd of ground water to the area; these are the Lower Cretaceous aquifers, Ozan Formation, Clayton Formation, Carrizo Sand, Cane River Formation, Cook Mountain Formation, and Jackson Group. Of these minor aquifers, only the Carrizo Sand is of sufficient areal extent to be considered a significant potential source of supply.

Paleozoic Aquifers

The northwestern part of WRPA 5 lies in the Ouachita Mountains, which are composed of folded and uplifted rocks of Paleozoic age. The rocks are dense and have no porosity except that created by fracturing along structural features. Ground water occurrence is erratic, and well yields are low (generally less than 50 gpm). Specific capacities are very low, and large drawdowns are required to produce small yields.

Ground water in the Paleozoic aquifers varies chemically due to lithologic differences in the water bearing rocks. It is generally of a mixed calcium and sodium bicarbonate type and is commonly hard and high in iron content.

Pumpage from Paleozoic aquifers is about 5 mgd, mostly from numerous small-capacity rural domestic and stock wells. Paleozoic aquifers are not considered a potential source for large development.

Cretaceous Aquifers

Tokio Formation

The Tokio Formation crops out in a small area in southwestern Arkansas. It dips southeastward and contains fresh water in an area of about 1,250 square miles. Flowing wells of low yield, generally less than 20 gpm, may be obtained in low lying areas.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

GEOLOGIC SOURCES OF GROUND WATER

WRPA 5

FIGURE 300

Because of the poor sorting of sands in the Tokio, permeabilities are low. Coefficients of transmissibility range from 1,300 to 4,500 gpd per foot, and well yields of about 300 gpm are possible. However, almost all wells tapping the aquifer are small-capacity rural supplies.

Water from the Tokio Formation is a soft, sodium bicarbonate type and, with local exceptions, is generally low in iron content. The dissolved-solids content of the water is low in the outcrop area and gradually increases downdip.

The Tokio Formation is neither a widely nor a heavily used aquifer. About 1 mgd is being withdrawn, but several times this amount is available.

Nacatoch Sand

The Nacatoch Sand crops out in a limited area in southwestern Arkansas and dips southeastward. It contains fresh water as far as about 15 miles downdip from the outcrop. Flowing wells are still obtainable in a few areas, but this condition will not last. The gradual lowering of head, largely caused by unrestricted flow of many wells, is eliminating areas of natural flow.

Sand in the Nacatoch is fine grained. Permeabilities are correspondingly low, as are coefficients of transmissibility, which range from 1,400 to 3,600 gpd per foot. Maximum well yields are about 300 gpm.

Water in the Nacatoch Sand is a soft, sodium bicarbonate type and is low in dissolved-solids content in the outcrop area. Downdip, the dissolved-solids content increases, and the water changes to a sodium chloride type. Iron content is low.

Withdrawals are about 1 mgd. Most is for rural use, but a few municipal and industrial supplies tap the Nacatoch.

Tertiary Aquifers

Wilcox Group

The Wilcox Group crops out in southwestern Arkansas and is composed of interbedded sand, silt, and clay. The individual sand beds are neither thick nor extensive, but in the aggregate they constitute a significant source for small to moderate supplies. Where it contains fresh water, the Wilcox is 200 to 300 feet thick; sand beds comprise 20 to 60 percent of the total thickness.

In addition to being very discontinuous, the sands are very fine grained. Therefore, transmissibilities vary considerably but are generally low, probably in the 5,000 to 20,000 gpd per foot range. Well yields are generally less than 200 gpm, and most wells yield only a few

gallons per minute. The aquifer is used almost exclusively for rural domestic and stock supplies. Yields as high as 500 gpm could be produced locally where sand thickness and available drawdown are sufficient.

In the outcrop area, water in the Wilcox Group is low in dissolved-solids content and is a soft, sodium bicarbonate type. However, the dissolved-solids content increases downdip, and the water changes to a sodium chloride type. Water quality is highly variable, and large differences in dissolved-solids content are common. This is likewise true of the most troublesome characteristic of Wilcox water, variable iron content, which can range from zero to an objectionable amount within a locale.

Many times the present withdrawals of 2.5 mgd from the Wilcox are obtainable. However, the expense of exploring for large supplies would be quite high as compared to that incurred in developing most aquifers because of the erratic and unpredictable occurrence of Wilcox sands. Also, a large supply would require wide spacing of relatively low-yield wells.

Carrizo Sand

The Carrizo Sand is the basal unit of the Claiborne Group and overlies the Wilcox Group in Arkansas [48]. It crops out in southwestern Arkansas and contains fresh water in an area of about 2,500 square miles in WRPA 5. In the extreme northeastern part of the area, it contains fresh water to depths of about 2,000 feet. The maximum thickness is more than 300 feet, but it is less than 200 feet thick in most of the area.

Little is known about the aquifer characteristics of the Carrizo Sand in Arkansas, as it is sparsely developed. The only known transmissibility value, 4,100 gpd per foot, is from a pumping test of a well in Hot Springs County where the sand is very thin. Transmissibilities should be in the 100,000 to 200,000 range where the aquifer is 100 to 200 feet thick. Well yields of 1,000 gpm or more should be obtainable.

Water in the Carrizo Sand is a soft, sodium bicarbonate type. It is generally low in iron content. The dissolved-solids content undergoes a very gradual increase downdip, as the water changes to a sodium chloride type.

The Carrizo Sand is virtually undeveloped (0.16 mgd withdrawals) in WRPA 5 because shallower aquifers have been utilized, leaving the Carrizo essentially unused. Because of this, water levels in the Carrizo are still high. The aquifer will be an extremely valuable source of water in the future.

Sparta Sand

The Sparta Sand is the most heavily used aquifer in WRPA 5, and it

is the most extensive. It is about 400 to 900 feet thick and contains fresh water to depths of more than 1,400 feet. The Sparta is composed of thin to massive sand beds with varying degrees of hydraulic interconnection. Although it is considered to function as a single hydrologic unit, fairly large head differences exist locally where extensive clays separate sands within the Sparta.

The total thickness of sands in the Sparta varies considerably but may average about 50 percent of the thickness of the formation. The extremes range from less than 100 to more than 800 feet of fresh-water bearing sand. In parts of southwestern Arkansas and northwestern Louisiana, the sands are especially thin and discontinuous, and large supplies are difficult to develop. In other areas where the Sparta contains massive sands, large supplies are obtainable. The wide range of known transmissibilities, 13,500 to 130,000 gpd per foot, may be representative of the range for individual sands; transmissibilities likely exceed 250,000 gpd per foot for the total thickness of sands [81]. Although the aquifer is poor locally, well yields of at least a few hundred gallons per minute are obtainable in most of the area where the Sparta contains fresh water.

Water in the Sparta Sand is generally of good quality and is only moderately mineralized. Fluoride content may be excessive locally. Iron may be present in quantities sufficient to require removal, but generally it is low. Water quality in the Sparta Sand is more consistent in a larger area than it is for any other major artesian aquifer in WRPA 5.

Pumpage from the Sparta is about 105 mgd, which is 48 percent of the total ground water used in WRPA 5. Average water level declines have already exceeded 100 feet, and pumping lifts are considerable in areas of large withdrawals. Although the aquifer is locally overdeveloped, additional supplies are available with careful regional planning. Future pumping centers can still produce large yields if they are located in areas least affected by existing cones of depression and are planned to minimize the danger of the coalscence of cones of depression.

Cockfield Formation

The Cockfield Formation contains fresh water in most of the central part of WRPA 5 and is generally about 100 to 200 feet thick. It contains beds of fine- to medium-grained lignitic sand; the sand beds are mostly in the lower part of the formation. The sands are discontinuous and the degree of interconnection appears low.

Known transmissibilities for the Cockfield range from 29,000 to 51,000 gpd per foot. Well yields are generally low (on the order of a few tens of gallons per minute), but yields of a few hundred gallons per minute are possible locally. Except for a few small public supplies,

almost all the water pumped from the Cockfield in WRPA 5 is for rural domestic and stock use.

Except where influenced by water from overlying aquifers, water in the Cockfield is generally a soft, sodium bicarbonate type. In places, it is hard or high in sulfate content as a result of water movement from the Quaternary aquifer or the Jackson Group, respectively. Iron occurrence is irregular and may be sufficient to require treatment. Dissolved-solids content and color increase downdip.

The Cockfield Formation furnishes about 3 mgd in the area and is capable of furnishing several times this amount. However, the aquifer is generally not well suited to support large supplies. In some areas, moderate supplies are possible with careful planning.

Miocene Deposits

Sands of Miocene age occur and contain fresh water only in a small area in the southern part of WRPA 5 and include the Carnahan Bayou, Williamson Creek, and Blounts Creek Members of the Fleming Formation. The deposits, mostly covered by Quaternary sediments, contain thick sandy zones interbedded with thinner clays. The sands thicken rapidly downdip to the south but contain fresh water only to depths of a few hundred feet in the area.

As the thickness and texture of the sands vary considerably, so do the water bearing characteristics. The coefficient of transmissibility ranges from 1,400 to 60,000 gpd per foot in tests of individual sands in Rapides Parish, La., just south of WRPA 5. Well yields of several hundred gallons per minute are obtainable from the thicker sands.

The water, which becomes salty with depth, is soft and low in dissolved solids where it is fresh. A slight hydrogen sulfide odor may be present, but iron content generally is not a problem. In places, the flouride content exceeds recommended limits.

Less than 3 mgd is withdrawn from Miocene aquifers in WRPA 5; almost all is used by public supplies. Several times this amount is available, but planning of large developments should take into account the proximity of underlying and downdip salty water.

Quaternary Aquifer

The Quaternary aquifer includes all Pleistocene and Holocene terrace and alluvial deposits and the Mississippi River Valley alluvial aquifer. For purposes of this report, they are considered a single hydrologic unit, although some segments act as separate aquifers. The Pleistocene deposits underlie the much finer grained Holocene alluvium in floodplains. The two are hydraulically continuous, but the coarse

sand and gravel of the Pleistocene is the most productive part of the aquifer. The aquifer contributes to the base flow of streams it underlies.

As the thickness and texture of the deposits vary considerably, the coefficient of transmissibility varies over a wide range (about 40,000 to 300,000 gpd per foot). Where the aquifer is well developed, well yields of 2,000 gpm are common; yields as high as 5,000 gpm have been obtained.

Water from the Quaternary aquifer is generally hard, a calcium bicarbonate type, and high in iron content. However, exceptions occur in some areas where the older alluvial or terrace deposits are exposed--the water may be soft, very low in disolved-solids content, and corrosive.

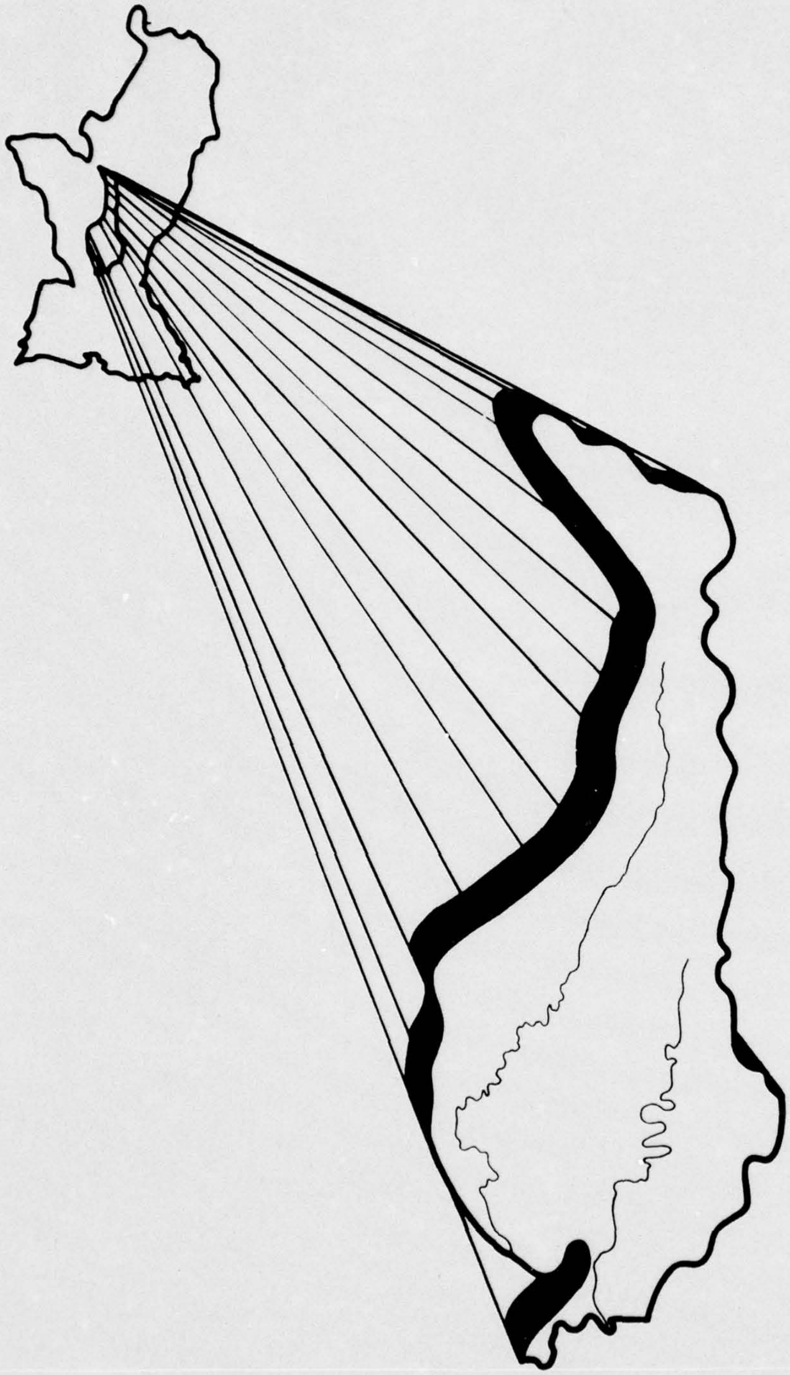
About 40 percent of the ground water pumpage in WRPA 5 comes from the Quaternary aquifer. The 80 mgd withdrawn is only a fraction of the amount available. In places where wells can be located near a major stream in contact with the aquifer, the amount available to wells becomes quite large due to the immediate recharge offered by the stream.

Effects of Ground Water Withdrawals and Management Considerations

The decline in the potentiometric surface of the Sparta Sand shows the effect of large-scale withdrawals and possible local overdevelopment. The postulated conditions upon which ground water availability estimates were made for this study have already been exceeded.

Large cones of depression in the potentiometric surface of the Sparta Sand have resulted from heavy withdrawals at Pine Bluff, El Dorado, and Magnolia, Ark., and Monroe, La. The cones are especially steep and deep at the latter three localities and reflect local overdevelopment. The resulting excessive pumping lifts, continued water level declines, and poor prospects for increasing pumpage suggest that these localities should be considered problem areas.

With aquifers such as the Tokio Formation, Nacatoch Sand, Wilcox Group, and Miocene deposits, developmental planning must take into account the proximity of salty water. Fresh water does not extend many miles downdip in these aquifers, and there is a potential for inducing salt-water encroachment.



WRPA 6

W R P A 6

INTRODUCTION

WRPA 6 is an area of northeastern Louisiana and southeastern Arkansas covering about 5,520 square miles, or 5.4 percent of the Lower Mississippi Region. About 112 square miles of the area are covered with water, and the remaining 5,408 square miles are land areas. The area lies in the large, alluvial floodplain of the Mississippi River, south of the Arkansas River and between the Mississippi River on the east and the higher ground on the west. It is protected from Arkansas and Mississippi River floods by a continuous levee beginning on the south bank of the Arkansas River near Pine Bluff, Ark., and extending down the west bank of the Mississippi River, thus forming the respective northern and eastern boundaries of the WRPA. The western boundary of the area is formed by the Bayou Bartholomew watershed boundary and the Ouachita and Black River levees, and the southern boundary is the Tensas-Cocodrie levee. Figure 301 shows the WRPA boundaries, stream patterns, State lines, major cities, and other pertinent features of the area.

Streams in the area averaged 15.7 inches of runoff per year, or about 6,400 c.f.s., during the past 20 years. The maximum runoff per year for the area was about 3.8 times the average annual, and the minimum about one-tenth of the average annual runoff.

The two principal streams in the area are the Boeuf River and the Tensas River. The Boeuf River rises in southeastern Arkansas and flows in a southwesterly direction about 230 miles to its confluence with the Ouachita River at mile 81.0. Its total drainage area is about 2,970 square miles. Its source is Canal 19, a realined drainage outlet in southeastern Arkansas which extends 74 miles from Lincoln County, Ark., to the head of Boeuf River west of Macon Lake. A major tributary of Boeuf River is the Big-Colewa Creek, which flows along the western edge of Macon Ridge and serves as the principal drainage outlet for 550 square miles of area between the Boeuf River and Bayou Macon.

Stream gradients within the Boeuf River Basin vary from less than 0.25 foot per mile near the mouth to about 1 foot per mile in the upper reaches. Average stream widths are about 250 to 300 feet in the lower reaches and 30 to 50 feet in the upper tributaries. The Boeuf River Basin ranges from about 25 miles in width in the lower reaches and narrows to about 10 miles in width upstream.

The Tensas River is formed in northeastern Louisiana and flows southerly about 165 miles to its confluence with the Black River at Jonesville, La. The total drainage area of the river is about 2,517 square miles. About 993 square miles, or 40 percent of the Tensas Basin

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

MEAN ANNUAL RUNOFF IN INCHES

WRPA 6

FIGURE 301

drainage area, is controlled by Bayou Macon. It rises in southeastern Arkansas and flows about 145 miles along the eastern edge of Macon Ridge to its junction with the Tensas River at mile 42.6.

Stream gradients in the Tensas Basin vary from about 0.2 foot per mile near the mouth of the Tensas to about 0.7 foot per mile in the upper reaches of the river. The lower 60 miles of the main channel is relatively wide and deep with some lake sections. Top bank widths vary from 300 to 600 feet, and channel depths from 40 to 60 feet. The river channel becomes progressively smaller in the upper reaches. Average widths of the Tensas Basin vary from 20 to 10 miles progressing from the mouth to the upper reaches, respectively [118].

The topography of WRPA 6 consists of fairly flat land with low natural terraces along the streambeds. The major surface relief in the area occurs along Macon Ridge, an area of rolling land about 10 miles in width which extends from Franklin Parish, La., to Chicot County, Ark. It rises from 10 to 40 feet above the adjacent areas [126].

Except in the Macon Ridge area, relief in the alluvial area ranges from elevation 50 in the southernmost part to elevation 95 in the upper areas. Along Macon Ridge, elevations vary from 75 to 150. The basin slope of WRPA 6 ranges from about 0.3 to 1.5 feet per mile. The Boeuf and Tensas River Basins are protected from headwater floods of the Ouachita, Arkansas, and Mississippi Rivers by topography and levees, but the lower parts of the basins are subject to overflow from the Red-Ouachita River backwater. Most of the soils in the area are recent alluvium consisting of alternate strata of clays, silts, and sands more than 100 feet in depth underlain by tertiary deposits. Soils along Macon Ridge are remnants of the aggradation plain of the interglacial era [117].

SURFACE WATER

Except for channel improvements, there has been relatively little development of the streams in WRPA 6. The major portion of the water produced in the area comes from rainfall in the winter and spring seasons. There is little regulation for flood control, but extensive modification has helped to lower flood stages. There is an interconnecting system of bayous and drainage ditches throughout the area which produces an interchange of flow under varying conditions; hence, flood flows and drainage areas at certain stations have been estimated [160]. Irrigation is important in the area, with small to large diversions occurring above various gaging stations throughout the WRPA. There is little navigational use of the streams in WRPA 6.

Quantity

The average annual discharge of the streams in WRPA 6 totals about 6,350 c.f.s., or 15.7 inches of runoff per year. This is equivalent to about 1.16 c.f.s. per square mile, which is an average figure compared with that for the rest of the Lower Mississippi Region.

Present Utilization

Withdrawals from surface water sources in WRPA 6 during 1970 were equivalent to less than 4 percent (217 c.f.s.) of the average annual flow generated within the area. This constituted about 45 percent of all the water withdrawn in the area, with the remaining 56 percent (275 c.f.s.) coming from ground water sources. Major withdrawals of surface water were for purposes of fish and wildlife enhancement (99 c.f.s.), irrigation (58 c.f.s.), and industry (51 c.f.s.), which comprised 46, 27, and 24 percent, respectively, of the total surface water withdrawals.

The major withdrawal from ground water sources in WRPA 6 during 1970 was for irrigation of row crops. An average of 180 c.f.s. was withdrawn for irrigation from ground water, which comprised about 76 percent of the total water withdrawn for this purpose. An additional 44 c.f.s. was withdrawn from ground water for use by industries in the area.

An average of about 330 c.f.s., or 67 percent of the total surface and ground water withdrawals in the area, was consumed. The remaining flows of 162 c.f.s. were released and returned to streamflow. This resulted in a net decrease to streamflow in the area of about 55 c.f.s. The major consumptive use of water was for irrigation. Approximately three-fourths (180 c.f.s.) of the water withdrawn for this purpose was consumed, with the remainder returned to nearby ditches and streams. Consumption for fish and wildlife enhancement averaged about 104 c.f.s.

Use of water for power production, municipal supply, and industry is negligible in WRPA 6 because the majority of the area is predominantly rural and no large municipalities or industries exist. Recreation is popular in the area, and most streams are used for nonconsumptive purposes such as fishing, boating, and related water sports.

Additional information on the withdrawals of ground and surface water in WRPA 6 during 1970 is given in table 15 of the Regional Summary. This table also presents pertinent data on the consumption of water for various purposes in this WRPA and each of the other areas in the Lower Mississippi Region.

Stream Management

An efficient method of stream management in the area serves to benefit all of the various users of the area's water resources. Stream management in WRPA 6 consists mainly of changes in stream systems, such as diversions for irrigation, the development of levees, construction of dams for impounding water, and changes in stream channels. Some of these changes were begun before records of streamflow were obtained in the area and others have been made so gradually that, even if the effect could be isolated, many subsequent years of record would be required to define them.

Impoundments. There is only one reservoir in the area which has a total capacity of 5,000 acre-feet or more. It is Turkey Creek Lake in Franklin Parish, La. The primary use of this impoundment is for recreational purposes. The total storage capacity of the lake is about 20,500 acre-feet, and its surface area is 3,100 acres.

Diversions. The majority of the diversions of water from streams in WRPA 6 are for irrigation of row crops during the dry seasons. The gaging stations of Boeuf River at Girard, La., and Bayou Macon at Kilbourne and Delhi, La., are affected by large diversions for irrigation. The Tensas River at Tendal, La., Boeuf River near the Arkansas-Louisiana State line, and Bayou LaFourche near Crew Lake, La., are affected by small diversions for irrigation [160].

Only a small amount of water is diverted in WRPA 6 for municipal and industrial purposes. Fish and wildlife purposes also require the diversion of water from streams of WRPA 6.

Channel modification. There has been a considerable amount of channel modification on the streams in WRPA 6 by the Corps of Engineers and the Louisiana Department of Public Works. The improvements have generally consisted of clearing, snagging, straightening, and enlarging of approximately 550 miles of channel on the Boeuf River, Bayou LaFourche, Tensas River, Bayou Macon, Big Creek, and Big Colewa Bayou.

The principal part of the work took place on the Boeuf and Tensas

Rivers and Bayou Macon during the period 1942-56. The Bayou LaFourche cutoff loop, which was completed in 1956 to provide a larger outlet into the Boeuf River, was a major phase of this project. In 1963, Canals 18, 19, 43, and 81 in the Boeuf River Basin were improved by enlargement and by clearing and snagging. On the Tensas River, clearing and snagging of the lower 62 miles was completed in 1971 [130].

This extensive project for channel work to improve the major agricultural drainage outlets in WRPA 6 has been in progress since 1947. Of the 997 miles of channel improvements authorized to date, 721 miles have been completed. This channel work has reduced the frequency and duration of flooding on 897,000 acres of rich alluvial lands, much of which has been recently cleared and placed in crop production [122].

Streamflow

In this study, various base periods of flow were used for the selected gaging stations due to the availability of discharge data at the sites. Periods of record for certain stations were modified to reflect changes in the streamflow characteristics, occasioned by changes in stream management, diversions, channel improvement, or regulation upstream from the site. For all of the selected stations, the period of record provides reasonably good discharge data for statistical analysis and study.

Measurement facilities. Streamflow data at seven sites in WRPA 6 were selected for presentation in this section. The streamflow at these sites is considered to be representative of the various drainage and hydrologic conditions which currently exist in the area. Locations of these selected sites are shown in figure 301, which is a map of the mean annual runoff in inches for the area, and these sites are identified by U. S. Geological Survey station numbers. Table 192 is a summary of the streamflow data at each of the selected sites and presents such data as

Table 192 - Streamflow Summary for Selected Sites, WRPA 6

Stream	Station	Agency	Station No.	Gage Datum (feet m.s.l.)	Drainage Area (square miles)	Period of Record 1/	Annual Flows (c.f.s.) Mean	Annual Flows (c.f.s.) Maximum	Annual Flows (c.f.s.) Minimum	Momentary Flows, (c.f.s.) Maximum	Momentary Flows, (c.f.s.) Minimum	Stage Data (feet m.s.l.) Highest	Stage Data (feet m.s.l.) Lowest
Boeuf River	Near Ark.-La. state line	USGS	73677	74.11	785	1958-68	958	2,827	260	16,500	0	96.8	74.6
Boeuf River	Girard, La.	USGS	73680	49.42	1,226	1955-69	203	522	90	3,070	10	70.9	52.3
Big Colewa	Oak Grove, La.	USGS	73685	0.00	42	1950-70	46	125	12	2,050	0	95.2	Dry
Bayou LaFourche	Crew Lake, La.	USGS	73690	37.08	361	1955-69	1,630	4,580	414	26,800	0	64.6	38.5
Tensas River	Tendal, La.	USGS	73695	50.07	309	1936-69	324	705	76	4,610	3	74.9	55.7
Bayou Macon	Kilbourne, La.	USGS	73697	75.41	504	1958-68	536	1,337	148	4,740	0	101.8	75.2
Bayou Macon	Delhi, La.	USGS	73700	50.05	782	1936-69	911	1,881	278	9,050	0	76.1	49.3

1/ This period of record applies to annual flows and not necessarily to momentary flows or stage data; however, the momentary flows and stage data occurred under conditions similar to that which existed during the period of record indicated.

the controlling agency, the drainage areas, period of record, gage datum, maximum and minimum stages and discharges, and other pertinent data for the station.

Average discharge for WRPA 6. A graphical representation of the average monthly discharge generated within WRPA 6 is shown in figure 302. This figure also presents the maximum monthly, minimum monthly, and 20 percent and 80 percent duration flows by months for WRPA 6. These monthly flows reflect the flows from Boeuf River and Tensas River Basins at the mouths of these respective streams and represent the majority of the flow from the entire WRPA. A map of isopleths showing the mean annual runoff for WRPA 6 is shown in figure 301.

Average discharge for selected stations. Tables 193-199 show the observed mean discharges by months for each of the selected streamflow gaging stations. Also shown are the average monthly and average annual flows for the period of record for each station. These flows reflect regulation and water use under 1973 levels of development.

Peak flow frequency curves for each of the selected sites are shown in figures 303-309. These curves are a reflection of the annual peak discharges at the station and were computed using the log Pearson Type III procedure [6].

Low flow frequency curves for most of the selected sites are shown in figures 310-314. These curves represent the lowest average flow for periods of 7, 30, 60, and 90 consecutive days. Due to the frequent occurrence of zero flows and the short period of record available, no low flow frequency curves were computed for gaging stations on the Boeuf River near the Arkansas-Louisiana State line or at Bayou Macon near Kilbourne, La.

Figures 315-321 present duration curves for daily flows at selected sites in WRPA 6. These curves show the percent of time that specified discharges were equaled or exceeded at the sites during given periods. The curves indicate flow characteristics of the streams throughout the entire range of discharges without regard to the sequence of occurrences. The maximum daily flows are listed on the curves because of the lack of space required to extend the curves to the zero percent exceedence probability point.

The slope of the duration curve is a quantitative measure of the variability of the streamflow, and a flat slope on the lower end depicts a well sustained flow, or a stream with a relatively high yield. The overall slope of the curves for streams having large low flow yields is usually flatter than those for streams having small low flow yields. For example, the duration curves for the Big Colewa near Oak Grove, La., and Bayou LaFourche near Crew Lake, La., are much steeper than the remainder of the curves in the area. This indicates that the streams have

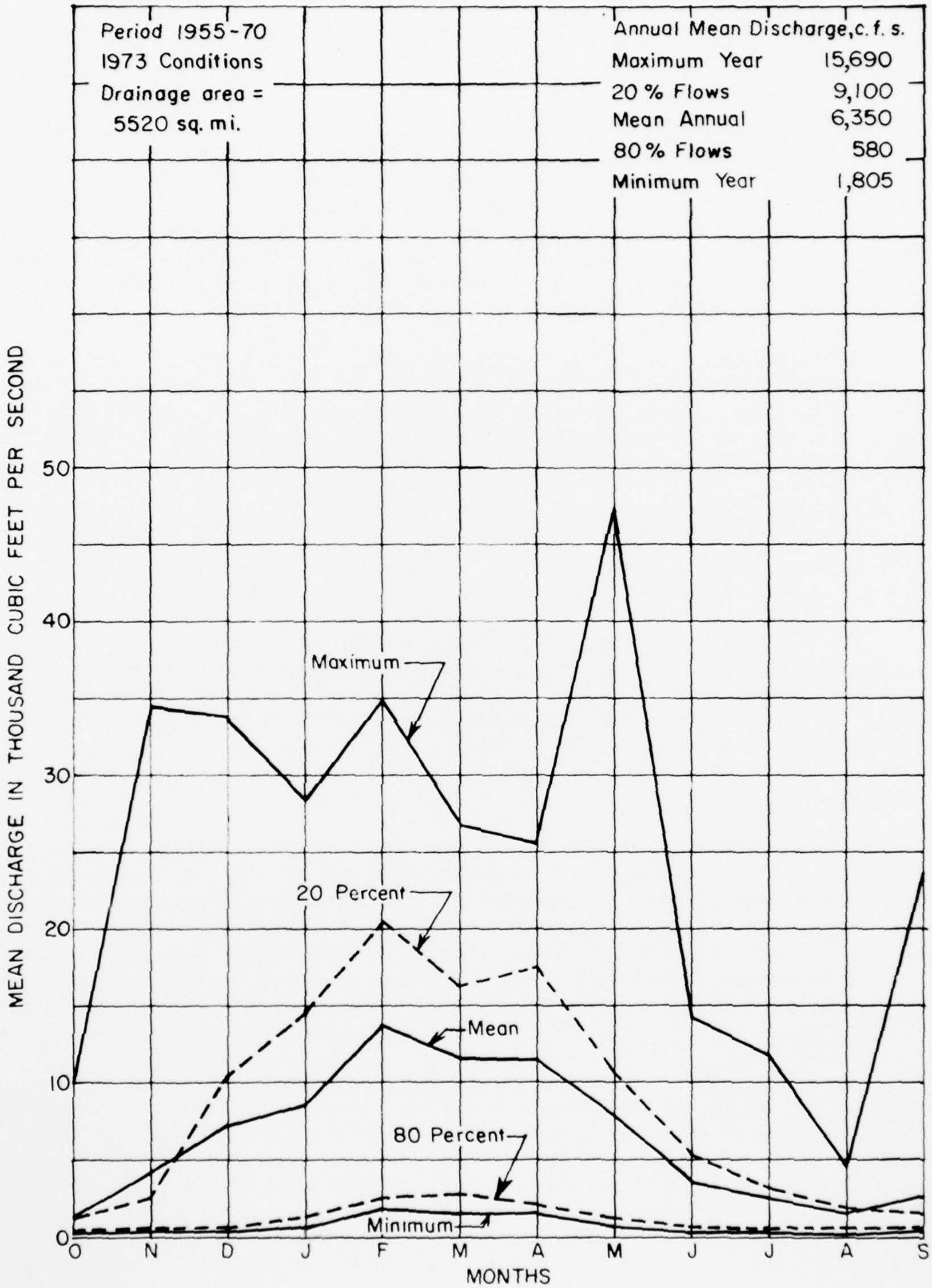


Figure 302 Monthly discharge from WRPA 6

small low flow yields. The reason for this is that the streams are cut into a shallow layer of the alluvium where little ground water is available [105].

Data on the dependable yield characteristics at each of the selected sites are shown in tables 200-206. These tables show the lowest mean flows for from one to ten consecutive years out of the period of record. The relationship of these lowest mean flows to the period of record mean flow is also shown.

The minimum annual flow for stations in WRPA 6 ranges between 24 and 45 percent and averages 30 percent of the mean annual flow. During the 10 consecutive years of lowest mean flow, the dependable yield averages about 84 percent of the mean annual flow for the WRPA.

Flow Velocities

No flow velocities for streams in WRPA 6 were available for publication in this report because no time of travel studies have been made in the area.

River Profile

A profile of the Boeuf River is shown in figure 322. This profile was constructed from topographic maps and data from available reports [117]. The 50 percent duration flow line was plotted from data at various gaging stations along the river. No profiles were available for the other streams in the area.

Quality

The quality of water in WRPA 6 is generally good. The chemical characteristics of water in the Boeuf and Tensas Rivers are representative of the quality of surface water in the subregion. The dissolved-solids content of water in the streams sampled ranged from 33 to 349 mg/1, the hardness from 19 to 222 mg/1, and the pH from 6.1 to 7.5. The dissolved solids in streams and ground water are derived from the rocks and soils with which the water has been in contact. Differences in the chemical composition and dissolved-solids concentration are due to the variation in the mineral composition of rocks and in the solubility of the minerals.

The principal dissolved constituents in the Boeuf and Tensas Rivers are bicarbonate, calcium, magnesium, and sodium. The water of these streams is a calcium magnesium bicarbonate type. Results of analysis of water from these streams are presented in table 207.

Table 193 - Observed Mean Discharge in c.f.s., Sta 73677.00, Boeuf River near Ark.-La. State Line, 1958-1968

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1958	607	5,773	1,790	2,228	631	2,051	2,819	9,565	1,710	971	355	5,427	2,827
1959	967	718	157	755	2,594	1,419	1,059	220	286	506	189	227	757
1960	148	115	666	1,405	1,620	2,431	273	508	173	75	226	160	649
1961	244	279	1,156	1,255	4,925	4,256	3,398	467	377	806	252	86	1,458
1962	71	1,653	4,914	3,991	1,523	969	679	300	816	115	64	134	1,269
1963	107	80	115	119	227	738	183	208	247	612	369	119	260
1964	64	70	494	710	230	1,471	3,163	700	51	48	64	90	596
1965	59	123	1,712	881	3,129	1,237	615	190	95	74	72	371	713
1966	50	45	66	158	4,499	158	190	809	14	54	166	92	525
1967	133	50	447	257	931	204	249	1,061	573	264	169	112	370
1968	54	36	772	3,962	902	1,748	2,396	2,226	228	181	139	734	1,114
Mean	227	812	1,117	1,429	1,928	1,516	1,365	1,477	415	336	187	686	958

Table 194 - Observed Mean Discharge in c.f.s., Sta 73680.00, Boeuf River near Girard, La., 1955-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1955	124	106	71	117	335	574	485	171	133	238	117	78	212
1956	84	92	118	80	791	383	326	103	91	66	62	59	187
1957	55	91	284	330	704	311	519	173	198	142	89	211	258
1958	164	1,027	336	398	198	423	376	1,905	257	193	110	887	522
1959	276	116	83	123	419	227	281	89	126	143	123	158	180
1960	105	109	191	236	309	421	106	101	76	33	72	58	151
1961	29	79	141	258	667	715	640	112	178	175	137	81	267
1962	90	246	932	515	257	232	178	151	121	69	37	18	237
1963	70	85	94	112	96	117	58	85	73	123	100	69	90
1964	64	48	119	173	126	246	408	241	70	46	79	54	139
1965	76	136	396	162	514	243	200	67	46	37	35	38	162
1966	--	--	--	--	--	--	--	--	--	--	--	17	--
1967	25	30	85	92	187	59	75	229	163	58	45	40	91
1968	32	46	150	647	159	283	534	307	87	81	91	97	209
1969	32	176	578	85	225	177	181	27	43	51	30	24	135
Mean	87	170	255	237	356	315	311	268	118	103	80	125	203

Table 195 - Observed Mean Discharge in c.f.s., Sta 73685.00, Big Colewa near Oak Grove, La., 1950-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1950	1	0	3	129	263	60	13	58	83	35	34	22	58
1951	1	6	98	230	119	56	29	31	1	19	0	0	49
1952	0	0	198	89	98	45	83	2	0	0	0	0	42
1953	0	0	4	18	245	95	67	277	2	3	0	0	59
1954	0	0	8	36	8	2	13	199	0	0	0	0	22
1955	1	6	3	29	110	257	60	1	0	67	42	0	48
1956	0	2	5	1	266	167	101	1	3	0	0	0	45
1957	0	14	76	112	161	28	135	3	54	7	1	12	50
1958	7	292	38	95	68	122	143	268	9	43	4	417	125
1959	13	1	0	3	39	58	52	0	6	4	0	15	15
1960	3	17	59	69	85	119	4	6	0	1	52	2	34
1961	1	8	34	39	239	193	79	2	13	13	1	4	51
1962	0	71	341	161	42	85	59	41	55	1	29	1	74
1963	1	9	5	7	28	50	17	5	1	11	10	1	12
1964	0	3	21	49	22	114	163	13	0	2	25	10	35
1965	1	47	144	37	160	85	25	7	2	3	4	14	44
1966	0	0	2	42	329	1	28	27	0	0	1	0	34
1967	0	2	30	2	29	9	19	45	86	26	1	0	21
1968	0	0	92	260	19	93	277	64	24	9	2	8	71
1969	2	164	238	2	58	50	54	1	9	28	0	1	51
1970	0	0	84	24	54	54	37	15	6	12	1	0	24
Mean	1	31	70	68	116	83	69	50	17	14	10	24	46

Table 196 - Observed Mean Discharge in c.f.s., Sta 73690.00, Bayou LaFourche near Crew Lake, La., 1955-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1955	3	15	6	401	2,604	5,446	3,721	866	123	1,040	198	20	1,203
1956	10	15	101	67	8,262	3,819	2,968	76	31	9	9	3	1,280
1957	13	288	1,567	2,694	5,843	2,194	5,213	1,500	1,640	540	111	472	1,839
1958	592	11,290	2,499	3,652	1,493	2,835	3,465	15,905	2,845	1,380	495	8,511	4,580
1959	1,554	694	241	829	3,920	2,376	2,250	353	535	786	206	359	1,175
1960	171	312	1,764	2,548	3,050	3,900	442	551	192	136	476	201	1,145
1961	256	497	1,422	2,220	7,376	6,945	5,403	-44	1,065	1,148	361	141	2,232
1962	92	2,916	10,279	5,142	2,455	1,843	1,250	905	1,102	122	123	128	2,196
1963	101	125	174	186	725	1,709	396	382	158	499	398	115	414
1964	18	43	793	1,495	491	3,006	4,773	1,928	79	63	194	124	1,083
1965	126	732	3,696	1,634	5,252	2,208	1,673	228	83	129	111	573	1,370
1966	52	47	170	975	9,467	291	1,393	1,479	[illegible]	86	211	111	1,191
1967	137	70	1,081	566	1,754	391	597	1,991	1,666	553	189	98	757
1968	28	29	1,665	7,084	1,377	2,981	6,373	3,588	672	421	792	1,676	2,223
1969	363	2,334	7,598	350	3,265	2,090	2,433	518	635	1,016	356	190	1,762
Mean	234	1,293	2,203	1,989	3,822	2,802	2,823	2,015	722	528	282	848	1,630

Table 197 - Observed Mean Discharge in c.f.s., Sta 73695.00, Tensas River at Tendal, La., 1936-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1936	--	--	--	--	--	--	181	687	57	32	16	13	--
1937	12	13	68	854	434	1,059	533	143	110	59	34	35	361
1938	25	42	110	458	503	558	1,773	280	111	109	99	24	340
1939	17	35	43	384	852	689	892	158	271	77	52	11	290
1940	9	16	48	90	851	386	810	917	139	1,524	186	38	417
1941	18	336	1,021	450	495	481	308	149	41	65	34	13	284
1942	10	221	128	84	199	746	880	492	99	41	18	14	244
1943	12	20	55	126	71	358	523	56	48	16	7	8	108
1944	5	9	12	281	352	670	1,249	950	94	22	16	12	306
1945	8	9	45	786	680	1,538	1,051	603	614	263	99	55	479
1946	183	85	159	2,030	2,254	1,215	465	879	793	234	111	54	705
1947	21	48	63	1,614	735	725	1,359	628	196	62	20	13	457
1948	10	76	256	153	1,031	850	243	69	31	24	357	22	260
1949	8	1,659	1,057	1,707	1,146	876	560	362	91	123	81	25	641
1950	24	18	28	498	1,624	959	128	513	494	275	383	118	421
1951	77	224	293	1,175	954	755	809	70	71	121	22	21	382
1952	13	14	191	178	433	454	382	119	71	20	18	14	158
1953	7	9	11	112	491	651	143	1,627	161	70	27	10	276
1954	8	8	39	68	142	51	44	688	13	7	9	10	90
1955	7	7	8	111	516	253	516	33	22	268	52	13	150
1956	8	8	24	14	1,313	770	686	69	29	26	30	13	249
1957	4	16	523	339	816	241	605	66	327	304	31	198	289
1958	208	1,826	716	602	340	806	405	1,579	443	149	70	758	658
1959	404	39	24	32	268	240	565	68	424	54	42	41	183
1960	17	27	202	250	555	669	48	94	22	17	115	55	172
1961	11	91	91	345	770	1,320	788	68	368	79	37	21	332
1962	20	303	1,788	1,163	539	561	521	272	109	100	20	23	451
1963	14	25	11	15	83	317	54	65	19	61	191	61	76
1964	9	11	48	233	162	689	953	278	14	40	58	27	210
1965	31	34	454	279	834	649	522	21	28	62	57	19	250
1966	--	--	--	--	--	--	--	--	--	--	--	--	--
1967	--	--	--	109	262	79	215	356	529	192	64	22	--
1968	7	9	521	1,182	191	650	1,019	572	180	111	86	63	535
1969	26	216	1,259	216	387	427	684	54	47	32	18	18	282
Mean	40	175	299	498	633	646	603	393	183	140	74	55	324

Table 198 - Observed Mean Discharge in c.f.s., Sta 73697.00, Bayou Macon near Kilbourne, La., 1958-1968

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1958	294	1,789	1,476	1,035	746	994	1,079	4,137	1,785	909	397	1,414	1,337
1959	1,232	435	362	390	1,184	891	637	253	154	195	117	153	500
1960	143	178	243	541	831	1,278	345	235	135	57	113	115	351
1961	101	126	454	747	1,191	2,015	1,959	536	402	486	383	190	715
1962	149	568	1,950	1,653	1,283	908	761	385	622	108	83	127	716
1963	99	105	96	88	73	225	106	74	34	360	434	82	148
1964	42	24	237	345	94	648	1,011	1,031	110	150	118	93	325
1965	78	88	887	488	1,271	673	634	169	127	81	62	166	393
1966	--	--	--	--	--	--	--	--	--	35	278	237	--
1967	75	63	115	255	332	149	73	611	230	150	83	75	229
1968	67	39	205	1,844	611	1,022	1,522	1,308	297	124	152	529	643
Mean	228	341	602	738	761	880	812	873	389	241	201	289	536

Table 199 - Observed Mean Discharge in c.f.s., Sta 73700.00, Bayou Macon near Delhi, La., 1936-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1936	145	146	152	400	639	268	371	567	102	242	209	103	278
1937	74	70	366	2,316	2,134	1,815	946	363	180	150	130	110	721
1938	297	635	833	1,824	1,653	1,552	3,305	856	345	229	258	155	995
1939	102	70	83	1,172	2,908	2,332	2,456	816	900	521	267	112	978
1940	87	87	187	213	1,349	1,095	1,928	1,658	423	2,366	784	237	867
1941	156	713	1,619	1,263	1,208	1,569	1,109	713	232	312	232	128	771
1942	119	632	365	357	365	1,431	2,764	1,562	657	293	155	94	732
1943	70	80	199	499	545	1,189	1,546	385	217	140	93	83	420
1944	74	73	69	430	1,145	2,386	3,535	3,189	1,284	369	191	193	1,078
1945	122	94	238	3,220	2,261	3,737	3,110	1,730	1,075	520	503	229	1,403
1946	356	436	911	3,765	4,303	2,747	1,720	1,373	1,426	698	326	176	1,519
1947	133	191	268	2,701	1,512	1,800	3,239	1,311	1,070	754	322	159	1,121
1948	145	467	1,066	966	3,291	3,414	2,304	1,074	500	224	459	158	1,172
1949	119	1,584	1,651	3,088	3,060	1,701	2,072	1,520	639	567	421	268	1,390
1950	397	860	827	2,842	3,606	3,167	2,346	1,800	1,285	558	495	1,059	1,603
1951	688	397	890	3,137	2,821	1,982	1,675	968	571	650	335	237	1,196
1952	187	146	1,154	1,252	2,291	1,919	1,788	881	405	173	132	113	870
1953	102	103	195	477	1,537	2,282	1,446	3,228	1,990	479	238	181	1,021
1954	132	112	339	677	1,108	563	397	2,079	478	85	49	81	508
1955	128	129	97	343	1,249	1,848	2,559	1,014	445	454	207	136	717
1956	178	114	149	112	2,965	2,649	1,554	233	100	94	101	99	695
1957	99	122	812	646	2,578	1,298	2,100	736	579	658	276	492	866
1958	454	2,767	2,513	1,760	1,292	1,957	1,438	4,080	2,816	1,321	539	1,645	1,881
1959	2,217	514	521	469	1,678	1,481	1,414	424	576	221	186	218	826
1960	168	208	573	908	1,520	2,038	516	336	165	75	247	172	577
1961	150	256	646	1,266	1,677	3,383	2,898	665	550	524	461	241	1,059
1962	198	951	2,627	2,339	1,788	1,435	1,015	719	775	156	131	142	1,022
1963	165	167	121	87	228	695	193	172	77	545	810	178	286
1964	102	95	414	875	438	1,491	2,011	1,304	134	201	185	173	618
1965	192	297	1,760	873	2,445	1,402	1,333	254	217	280	176	354	798
1966	189	199	203	487	3,646	613	697	684	117	85	199	175	607
1967	173	183	226	376	491	333	261	907	730	369	202	189	370
1968	184	146	720	3,517	810	1,567	3,161	1,824	472	302	268	561	1,127
1969	303	847	3,562	535	1,563	896	1,460	344	380	326	256	244	892
Mean	247	408	775	1,329	1,826	1,765	1,784	1,169	644	439	.289	261	911

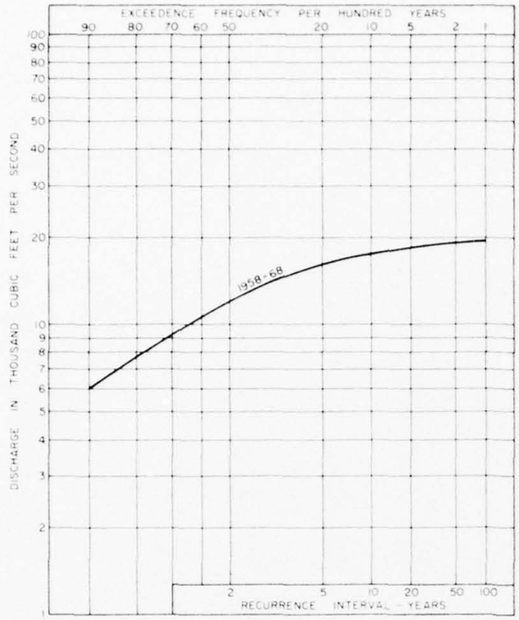


FIGURE 303 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3677 BOEUF RIVER NEAR ARK.-LA STATE LINE

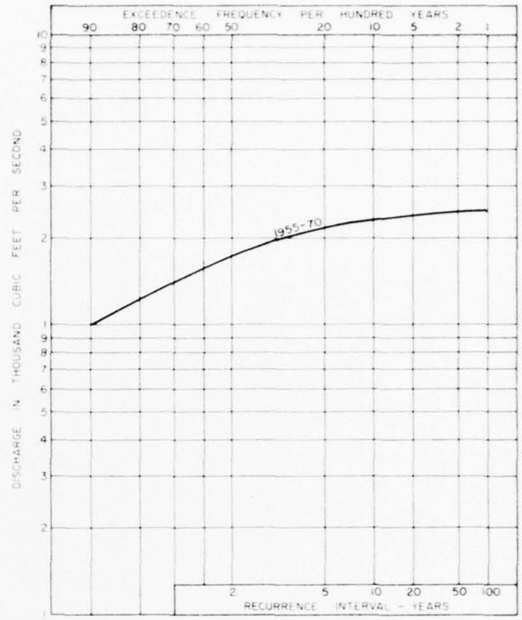


FIGURE 304 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3680 BOEUF RIVER NEAR GIRARD, LA

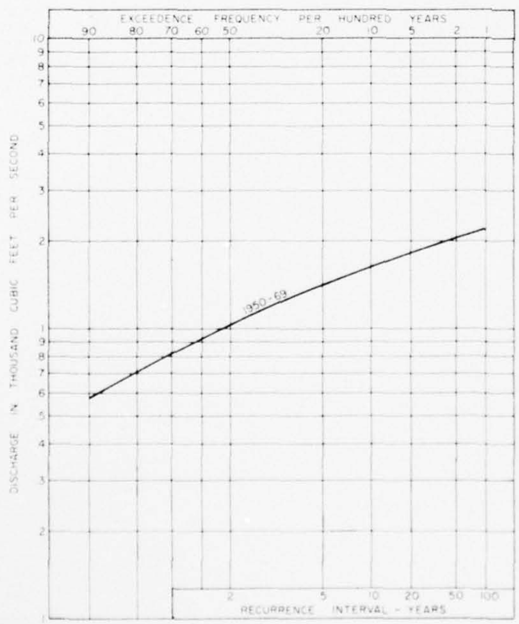


FIGURE 305 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3685 BIG COLEWA BAYOU NEAR OAK GROVE, LA

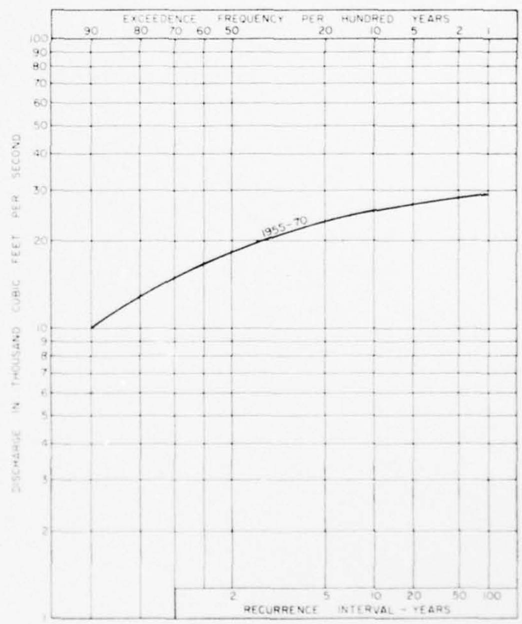


FIGURE 306 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3690 BAYOU LAFOURCHE NEAR CREW LAKE, LA

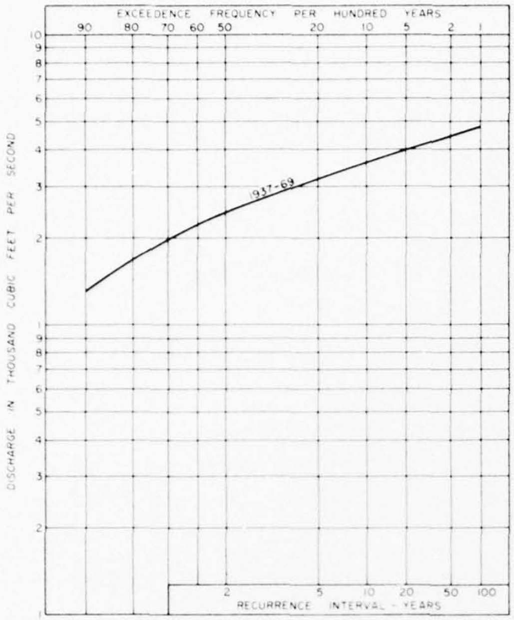


FIGURE 307 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3695 TENSAS RIVER AT TENDAL, LA

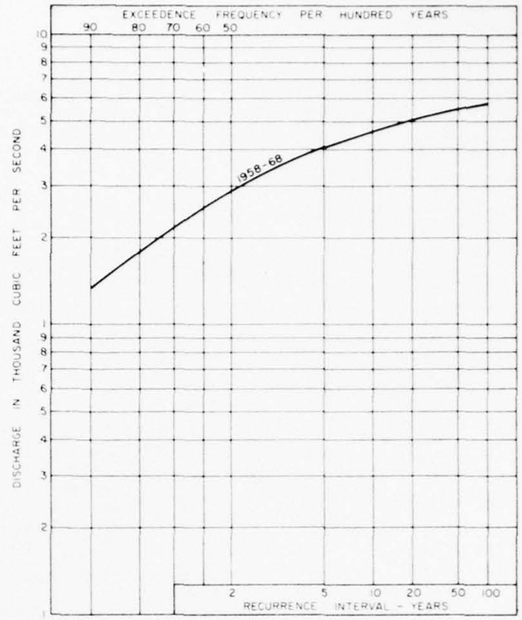


FIGURE 308 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3697 BAYOU MACON NEAR KILBOURNE, LA

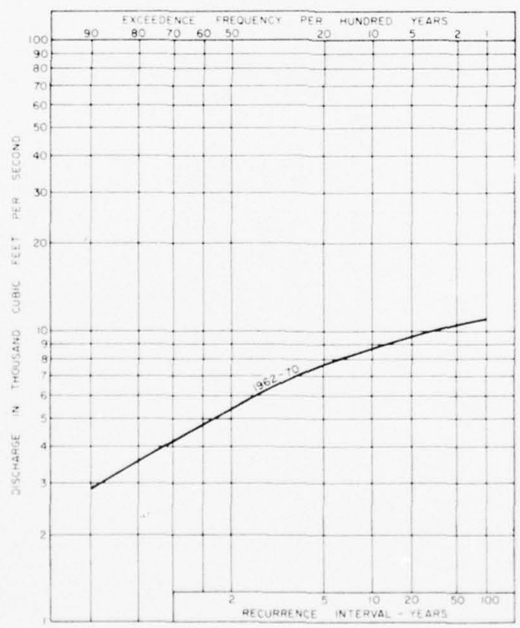


FIGURE 309 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3700 BAYOU MACON NEAR DELHI, LA

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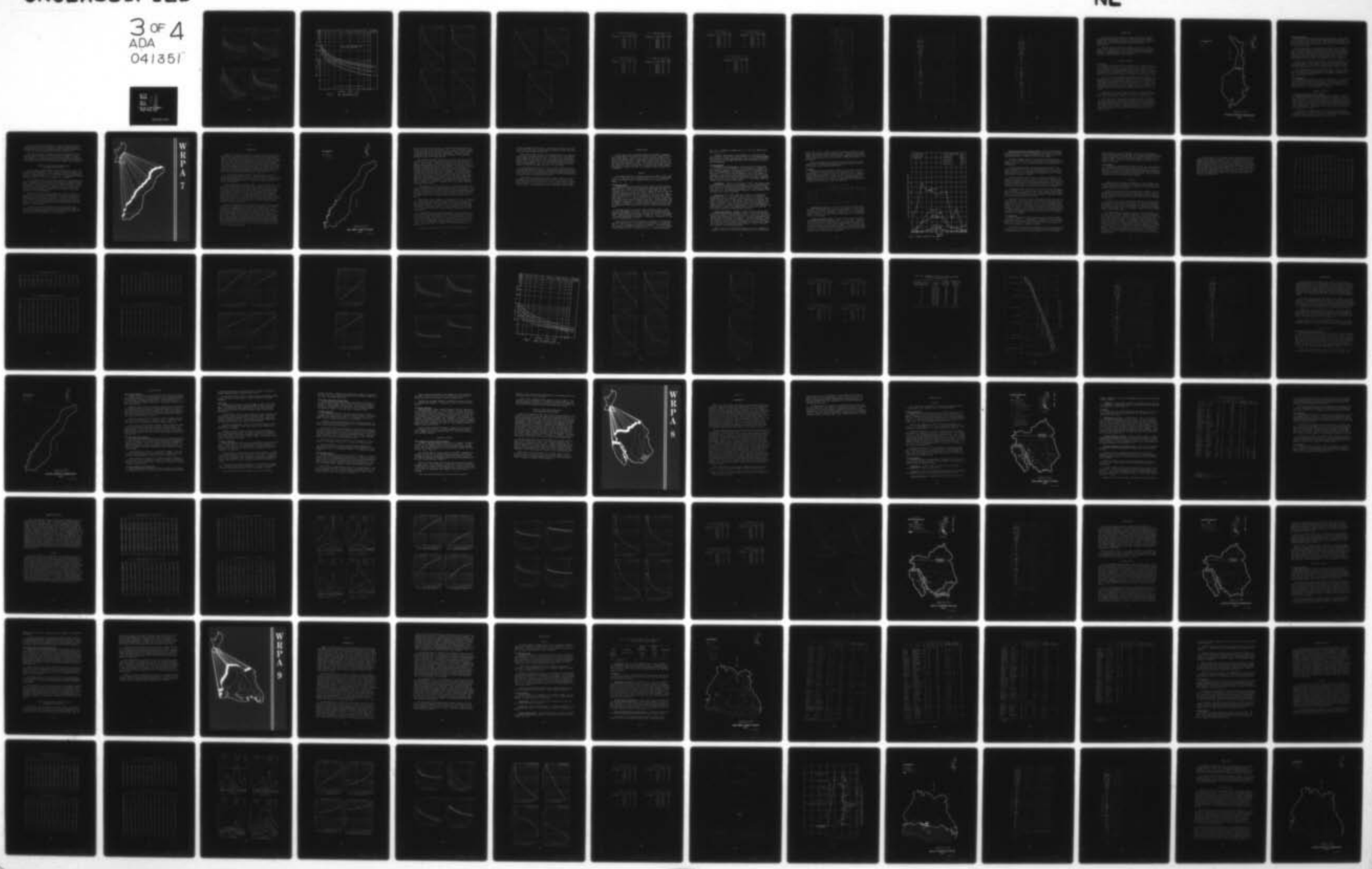

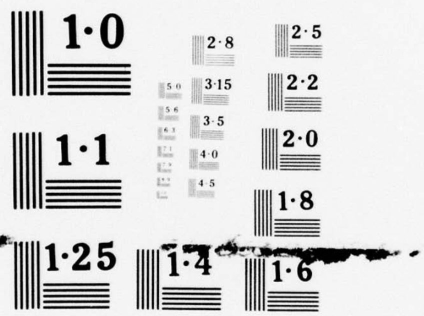

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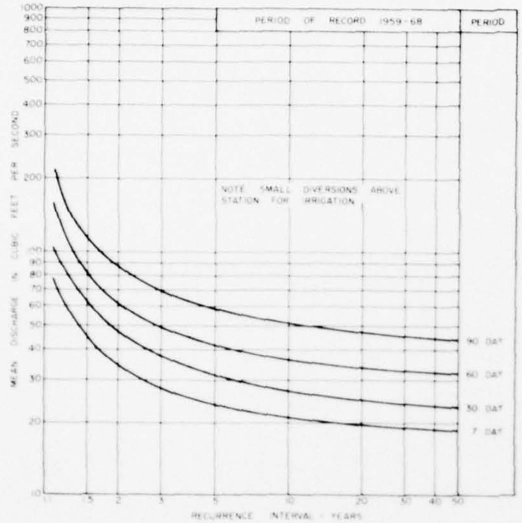


FIGURE 310 LOW FLOW FREQUENCY CURVES
7-3677 BOEUF RIVER NEAR ARK-LA LINE

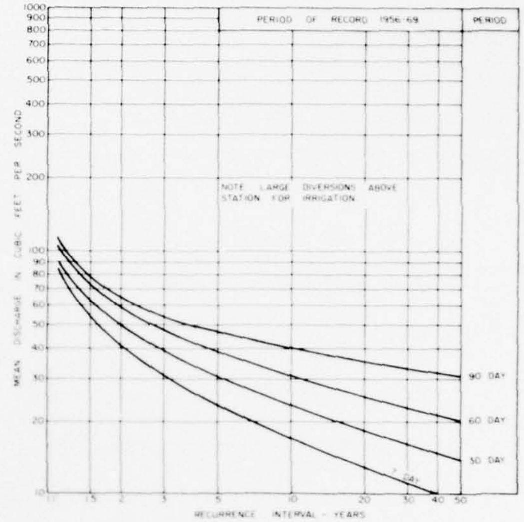


FIGURE 311 LOW FLOW FREQUENCY CURVES
7-3680 BOEUF RIVER NEAR GIRARD, LA

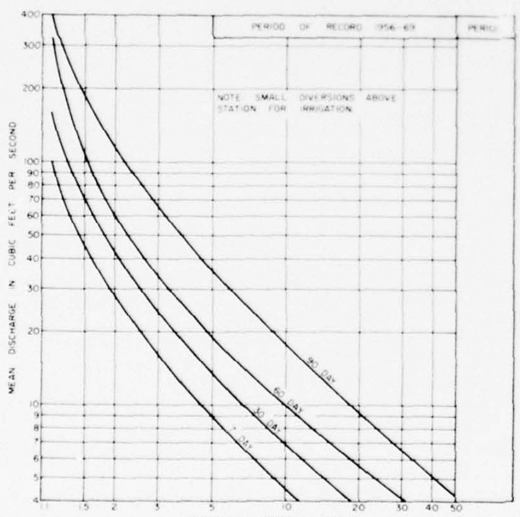


FIGURE 312 LOW FLOW FREQUENCY CURVES
7-3690 BAYOU LAFOURCHE NEAR CREW LAKE, LA

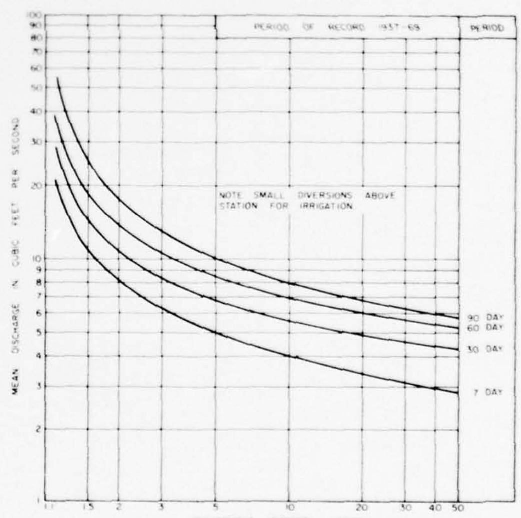


FIGURE 313 LOW FLOW FREQUENCY CURVES
7-3695 TENSAS RIVER AT TENDAL, LA

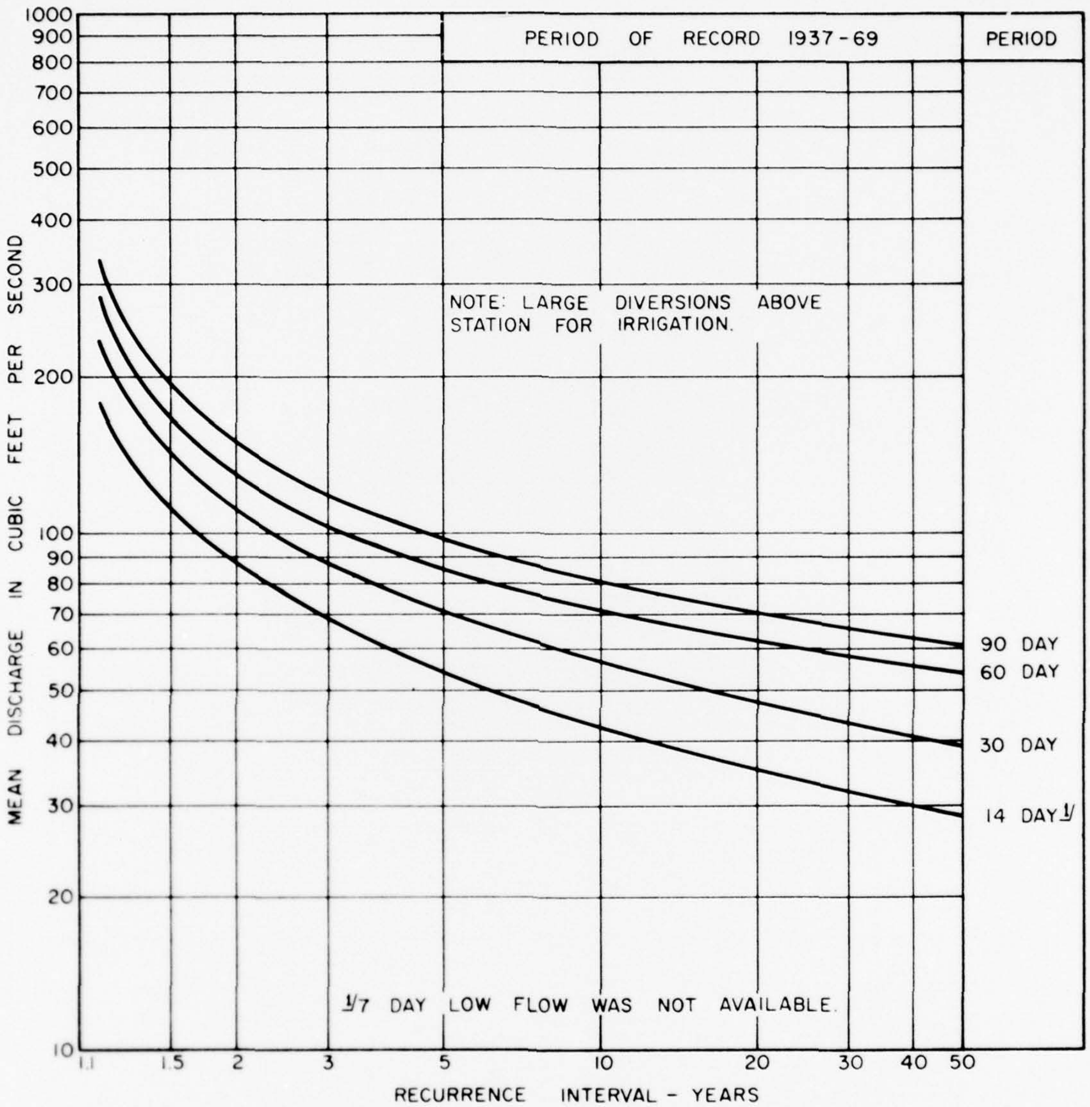


FIGURE 314 LOW FLOW FREQUENCY CURVES
7-3700 BAYOU MACON NEAR DELHI, LA.

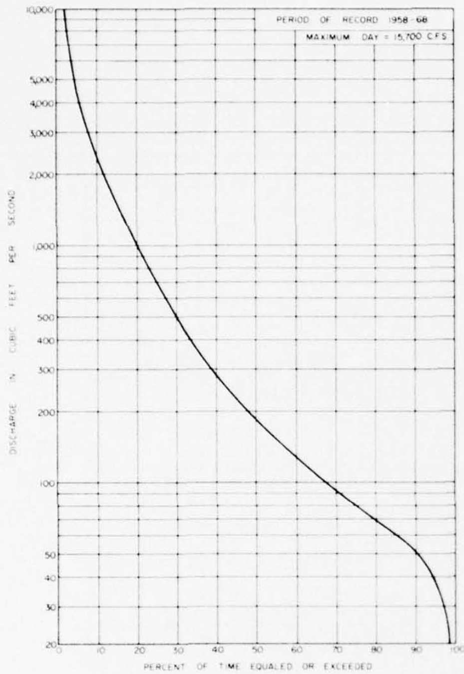


FIGURE 315 DURATION CURVE
7-3677 BOEUF RIVER NEAR ARK-LA STATE LINE

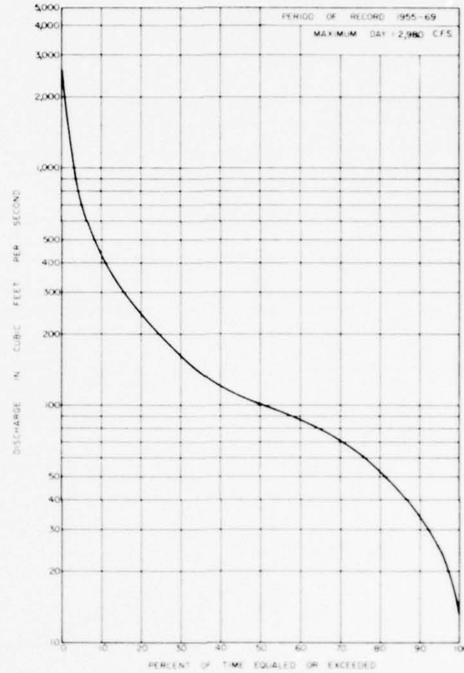


FIGURE 316 DURATION CURVE
7-3680 BOEUF RIVER NEAR GIRARD, LA

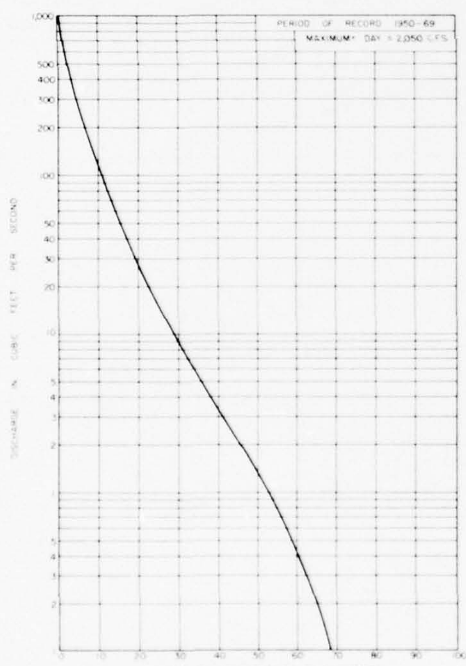


FIGURE 317 DURATION CURVE
7-3685 BIG COLEWA BAYOU NEAR OAK GROVE, LA

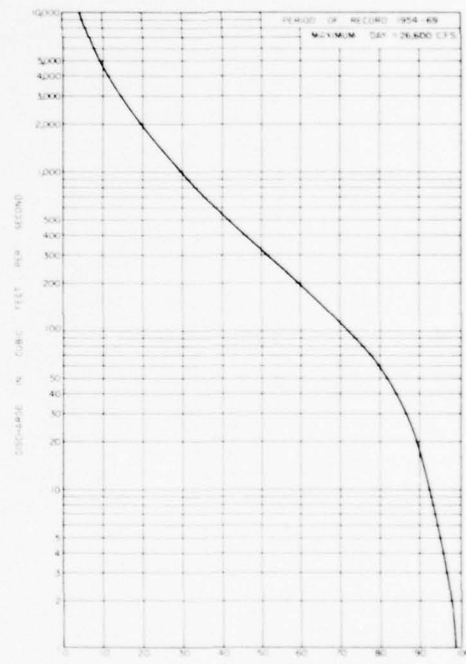


FIGURE 318 DURATION CURVE
7-3690 BAYOU LA FOURCHE NEAR CREW LAKE, LA

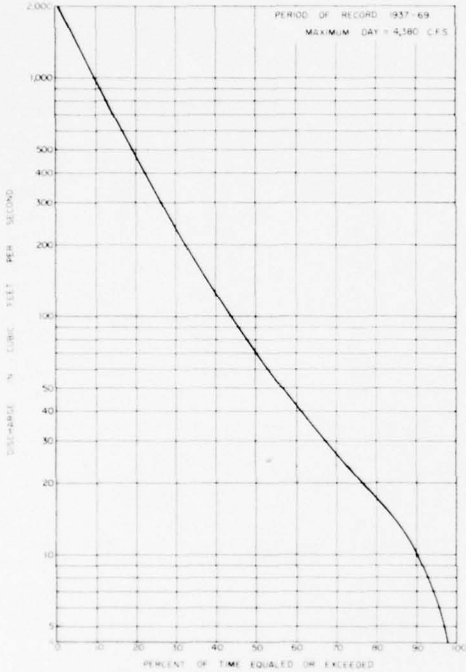


FIGURE 319 DURATION CURVE
7-3695 TENSAS RIVER NEAR TENDAL, LA

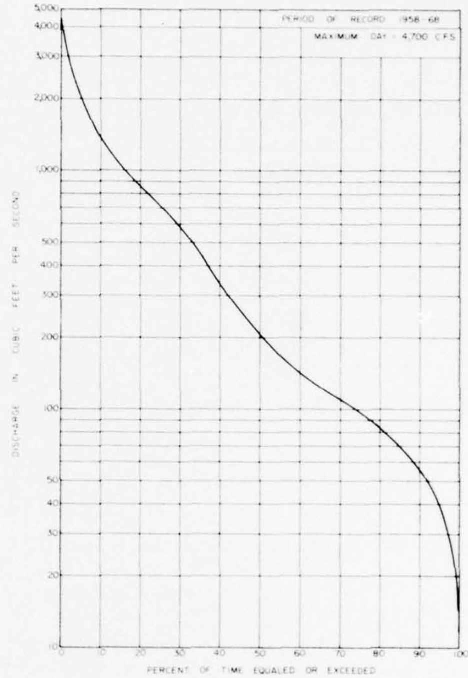


FIGURE 320 DURATION CURVE
7-3697 BAYOU MACON NEAR KILBOURNE, LA

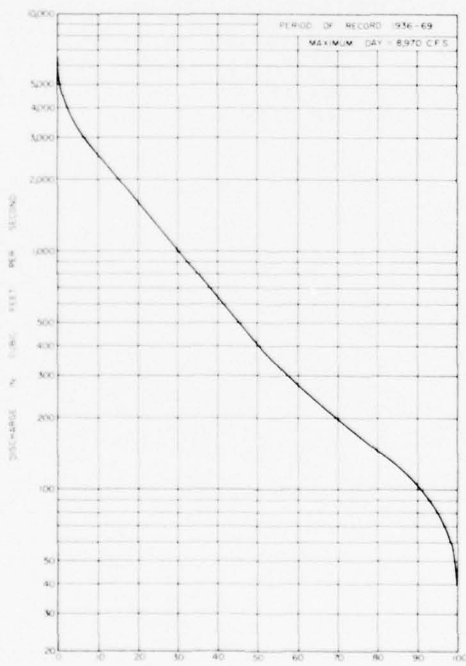


FIGURE 321 DURATION CURVE
7-3700 BAYOU MACON NEAR DELHI, LA

Table 200 - Dependable Yield at Sta 73677.00, Boeuf River near Ark.-La. State Line

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1958-1968 Mean
1	1963-1963	260	27.1
2	1963-1964	428	44.7
3	1963-1965	523	54.6
4	1963-1966	523	54.6
5	1963-1967	492	51.4
6	1963-1968	596	62.2
7	1962-1968	692	72.2
8	1960-1967	730	76.2
9	1959-1967	733	76.5
10	1959-1968	771	80.4
11	1958-1968	958	100.0

Table 201 - Dependable Yield at Sta 73680.00, Boeuf River near Girard, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1955-1969 Mean
1	1963-1963	90	45.3
2	1966-1967	113	56.8
3	1965-1967	129	65.0
4	1963-1966	131	66.1
5	1963-1967	123	62.1
6	1963-1968	137	69.2
7	1963-1969	137	69.0
8	1962-1969	149	75.3
9	1959-1967	161	81.1
10	1960-1969	161	81.3
15	1955-1969	198	100.0

Table 202 - Dependable Yield at Sta 73685.00, Big Colewa near Oak Grove, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1950-1960 Mean
1	1959-1959	15	29.9
2	1959-1960	24	48.8
3	1954-1956	38	76.3
4	1954-1957	41	82.1
5	1952-1956	43	86.0
6	1951-1956	44	87.9
7	1951-1957	45	89.6
8	1950-1957	46	92.8
9	1952-1960	48	97.3
10	1951-1960	48	97.4
11	1950-1960	50	100.0

Table 203 - Dependable Yield at Sta 73690.00, Bayou LaFourche near Crew Lake, La., 1955-1969

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1955-1969 Mean
1	1963-1963	414	25.4
2	1963-1964	748	45.9
3	1963-1965	955	58.6
4	1963-1966	1,014	62.2
5	1963-1967	963	59.1
6	1962-1967	1,168	71.7
7	1963-1969	1,257	77.1
8	1960-1967	1,298	79.6
9	1959-1967	1,284	78.8
10	1959-1968	1,378	84.6
15	1955-1969	1,630	100.0

Table 204 - Dependable Yield at Sta 73695.00, Tensas River at Tendal, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1937-1969 Mean
1	1963-1963	76	23.9
2	1954-1955	120	37.8
3	1954-1956	163	51.3
4	1952-1955	168	53.0
5	1952-1956	184	58.1
6	1952-1957	202	63.6
7	1951-1957	227	71.7
8	1960-1967	238	74.9
9	1959-1967	231	73.0
10	1952-1961	255	80.5
33	1937-1969	317	100.0

Table 205 - Dependable Yield at Sta 73697.00, Bayou Macon near Kilbourne, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1958-1968 Mean
1	1963-1963	148	28.9
2	1963-1964	236	46.1
3	1963-1965	288	56.3
4	1963-1966	286	55.8
5	1963-1967	274	53.6
6	1963-1968	336	65.5
7	1962-1968	390	76.1
8	1960-1967	394	76.9
9	1959-1967	406	79.2
10	1959-1968	429	83.8
11	1958-1968	512	100.0

Table 206 - Dependable Yield at Sta 73700.00, Bayou Macon near Delhi, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1936-1969 Mean
1	1936-1936	278	30.5
2	1963-1964	452	49.6
3	1963-1965	567	62.2
4	1963-1966	577	63.3
5	1963-1967	535	58.8
6	1962-1967	616	67.7
7	1963-1969	671	73.6
8	1960-1967	667	73.2
9	1959-1967	684	75.1
10	1959-1968	729	80.0
34	1936-1969	911	100.0

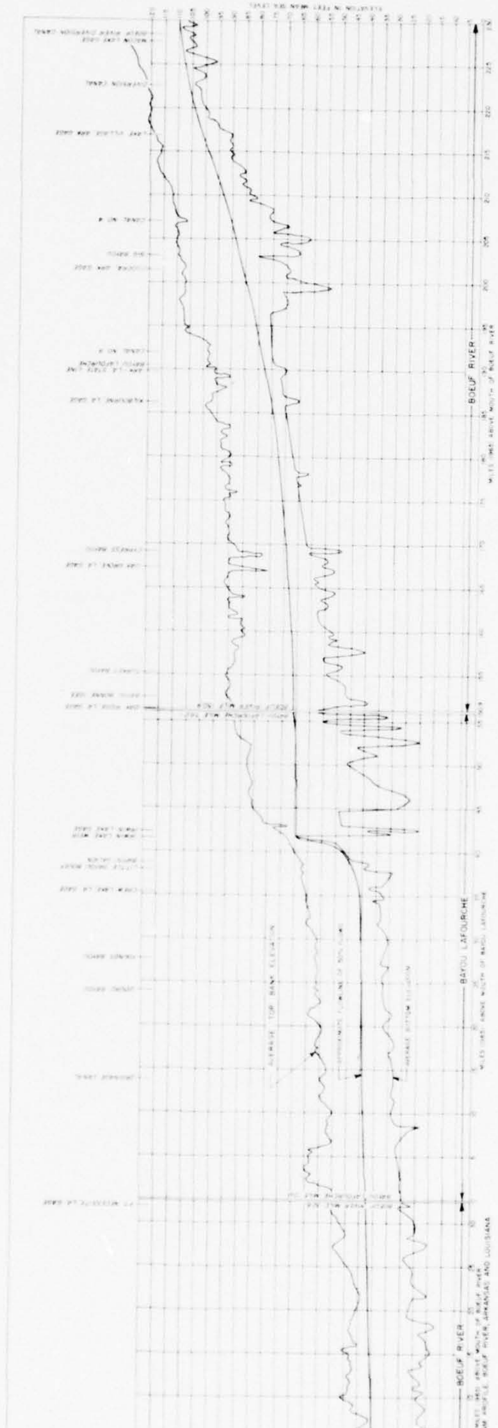


FIGURE [illegible] STREAM PROFILE, BOEUF RIVER, ARKANSAS AND LOUISIANA

Table 207 - Chemical Analyses of Water from Streams in WRPA 6 in the Lower Mississippi Region, Milligrams Per Liter

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
	07364300 Chemin-a-Haut Bayou (Creek) near Beekman, La. (drainage area, 271 sq mi)																		
Terrace deposits and alluvium	11-14-60	20	0.9	--	19	5.8	17	4.3	100	1.4	20	0.4	1.0	119	72	0	219	7.1	17
	8-14-62	3.8	11	0.12	24	7.6	23	3.4	132	2.8	23	.2	.2	160	91	0	289	6.4	5
	07368520 Big Creek at Holly Ridge, La. (drainage area, 71 sq mi)																		
	10-11-60	0.23	0.9	0.15	5.4	1.3	2.0	4.3	23	3.4	2.5	0.2	2.0	33	19	0	55	6.7	100
	8-16-62	2.2	6.5	.20	4.8	1.8	2.1	4.1	24	4.2	2.8	.2	.8	40	19	0	65	6.1	80
	07367700 Boeuf River near Ark.-La. State Line																		
	10-14-70	2100	2.2	0.03	24	6.1	17	6.0	86	16	28	0.1	2.9	151	85	14	273	7.0	35
	11-18-70	360	7.7	.09	27	4.0	9.3	6.0	96	12	13	.2	1.0	159	84	5	222	7.0	60
	12- 8-70	54	12	.04	39	11	25	6.0	143	27	40	.2	1.4	250	140	27	417	7.5	30
	1-21-71	99	9.3	.04	29	8.6	18	4.0	107	22	29	.2	1.3	229	110	20	309	7.4	40
	3- 9-71	152	7.2	.03	22	6.1	13	4.0	87	13	17	.2	1.0	151	80	9	223	7.0	60
	4-21-71	700	11	--	45	14	35	1.7	173	31	50	.2	1.4	283	170	28	490	6.3	10
	6-10-71	150	10	.02	45	14	34	3.6	169	24	56	.2	.1	321	170	29	495	7.3	20
	7-21-71	33	13	--	51	17	40	3.3	202	26	67	.2	.2	336	200	31	591	7.4	10
Alluvium	8-25-71	--	8.5	.05	32	9.7	22	3.9	134	13	35	.2	.2	205	120	10	352	7.3	30
	07368000 Boeuf River near Girard, La.																		
	11-16-70	--	11	0.09	30	9.0	19	6.8	106	22	34	0.2	1.2	215	112	25	330	7.3	40
	1-26-71	--	10	--	27	7.2	12	4.0	100	17	17	.1	1.8	146	97	15	249	7.2	80
	3-18-71	--	7.9	.11	15	5.5	10	6.0	67	11	14	.4	1.5	130	60	12	170	7.0	80
	5-18-71	--	7.4	.08	8.0	2.2	4.0	2.8	28	5.0	3.3	.2	7.3	71	29	6	82	6.8	100
	7- 9-71	--	13	.02	39	11	24	2.8	152	19	34	.2	1.3	230	140	17	391	7.3	20
	9-22-71	--	18	.11	58	19	35	3.2	230	24	58	.2	.5	349	220	33	571	6.9	15
	07369500 Tensas River at Tendal, La.																		
	11- 7-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	274	--	--
	11-16-70	--	7.5	0.06	15	4.0	3.2	7.5	63	8.8	3.1	0.2	3.1	131	54	2	141	7.1	60
	11-21-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	189	--	--
	12-18-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	303	--	--
	1-26-71	--	10	.08	35	9.9	10	3.9	153	14	9.0	.1	1.2	186	130	2	282	7.5	35

Table 207 - Chemical Analyses of Water from Streams in WRPA 6 in the Lower Mississippi Region, Milligrams Per Liter--Continued

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
	07369500 Tensas River at Tendal, La.--Continued																		
	1-27-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	292	--	--
	2-27-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	122	--	--
Alluvium--Continued	3-18-71	--	9.8	0.03	23	6.4	6.1	6.7	107	3.4	2.3	.3	2.1	120	84	0	189	7.3	80
	3-27-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	287	--	--
	5-18-71	--	12	.05	15	1.6	5.0	6.2	57	5.6	1.0	.2	4.1	93	44	0	120	6.7	--
	7- 9-71	--	10	.05	23	6.0	10	3.5	109	6.6	5.8	.2	3.0	134	82	0	206	6.9	40
	9-22-71	--	18	.11	56	18	28	3.4	304	4.4	16	.3	.2	300	210	0	502	7.2	20

GROUND WATER

Two Tertiary aquifers and the Mississippi River Valley alluvial aquifer constitute the major sources of fresh ground water in WRPA 6 (figure 323). The Quaternary alluvial and terrace deposits blanket the entire area, and the underlying Tertiary beds dip generally southeastward.

About 280 mgd of ground water is pumped in the area. Of this amount, about 95 percent is from the Mississippi River Valley alluvial aquifer. The remainder comes from the Sparta Sand and the Cockfield Formation. Miocene deposits contain fresh water in the southernmost part of the area, but they are not utilized.

Tertiary Aquifers

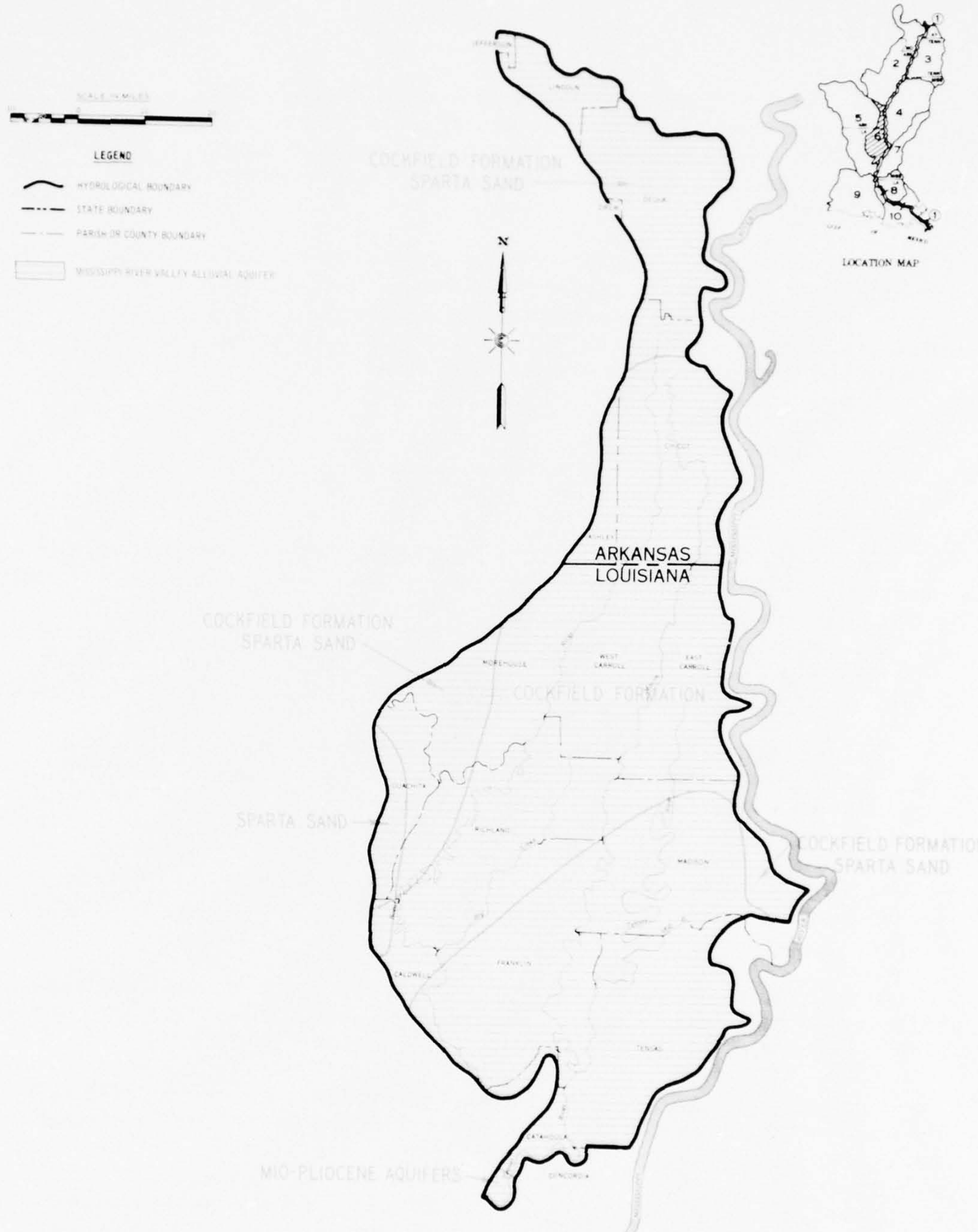
Sparta Sand

The Sparta Sand underlies all of WRPA 6, but it contains saline water in most of the area. It contains fresh water in one area in Arkansas and two areas in Louisiana (one of which is quite small). The Sparta, composed of interbedded sands and clays, is generally considered to function as a hydrologic unit. The entire unit is 600 to 1,000 feet thick, 20 to 80 percent of which may be composed of water-bearing sands.

The sands are fine to medium grained and are generally thicker in the lower part of the formation. Transmissibility values obtained from pumping tests of individual sands range from 20,000 to 24,000 gpd per foot; higher values could be expected in massive sands. Values as high as 250,000 may be possible if total sand thickness is considered [81]. Although not everywhere present, the thicker sands are in the 100- to 300-foot range and may yield several hundred to more than 1,000 gpm to wells.

Where water in the Sparta Sand is fresh, it is of good quality, a soft sodium bicarbonate type. Fluoride and iron content may be excessive locally as may iron. However, iron content is generally low.

More than 13 mgd is pumped from the Sparta in WRPA 6. Although this amount approximates the quantity estimated to be available under conditions postulated in this study, almost all of it is withdrawn at one overdeveloped locality--the Bastrop area, which is also affected by the drawdown cone at Monroe. Additional supplies are available elsewhere in the area where water levels are less affected by these two pumping centers.



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

GEOLOGIC SOURCES OF GROUND WATER

WRPA 6

FIGURE 323

Cockfield Formation

Sands in the Cockfield Formation contain fresh water in more than half of the area. The sands are fine to medium grained, generally lignitic, and may be silty. Most of the sands, especially the thicker ones, are in the lower part of the formation. The sands are discontinuous and not well interconnected.

Most of the sands are less than 100 feet thick, and known coefficients of transmissibility are 50,000 gpd per foot or less. However, where sands are as much as 200 feet thick locally, the transmissibility may be as high as 100,000 gpd per foot. Well yields of several hundred gallons per minute are generally available, but yields in excess of 1,000 gpm are possible locally. The Cockfield is used by a few small public supplies as well as many rural domestic and stock supplies.

Water in the Cockfield is generally a soft sodium bicarbonate type. Local high hardness or iron content results from water movement from overlying aquifers. Color, which is caused by the presence of organic material in the aquifer, may be high and generally increases downdip.

The Cockfield Formation furnishes about 3 mgd in the area. Much more is available with wide distribution of pumping. Although the aquifer is not suited to the development of large supplies, moderate supplies are available locally.

Miocene Deposits

In WRPA 6, Miocene Sands contain fresh water only in a very small locality in the southern part of the area. In addition, the fresh-water bearing part of the Miocene deposits is thin and overlies salty water. For these reasons, the Miocene Sands are not considered a significant source of fresh-water supplies in WRPA 6.

Quaternary Aquifers

Mississippi River Valley Alluvial Aquifer

The Mississippi River Valley alluvial aquifer includes all Pleistocene and Holocene terrace and alluvial deposits in WRPA 6. Thickness ranges from about 50 to more than 150 feet but is more than 100 feet in most of the area. The Pleistocene deposits are generally coarse sand or gravel at the base and grade finer upward; they constitute the main part of the aquifer and are overlain by the very fine-grained Holocene alluvium in floodplains. Ground water in the alluvial aquifer contributes to the base flow of streams.

Coefficients of transmissibility as determined by pumping tests range from 90,000 to 240,000 gpd per foot. This range is probably representative for the aquifer in this area. Well yields of a few thousand gallons per minute are available in much of the area.

Water from the alluvial aquifer is generally hard, calcium bicarbonate type, and high in iron content. However, exceptions exist in some upland areas where the terrace deposits are exposed--the water may be soft, very low in dissolved-solids content, and corrosive.

More than 260 mgd is withdrawn from the Mississippi River Valley alluvial aquifer in WRPA 6. Most of this water is pumped by large-capacity wells for irrigation. Several times this amount is available on a regional basis, and the amount could be increased still further by locating wells near major streams that are in contact with the aquifer.

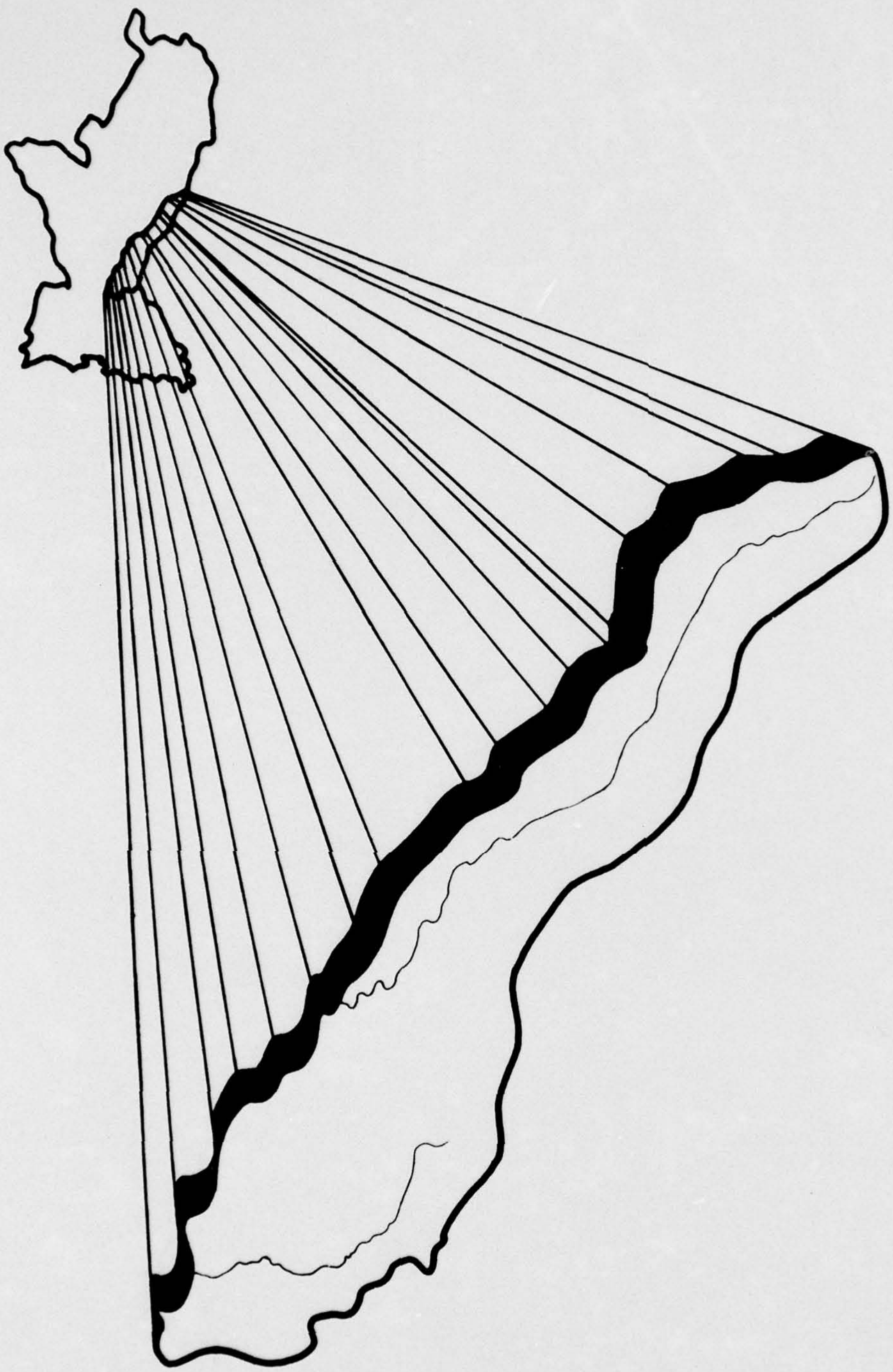
Effects of Ground Water Withdrawals and Management Considerations

The only major aquifer in WRPA 6 seriously affected by water level declines is the Sparta Sand. Cones of depression have developed as the result of heavy withdrawals in the vicinities of Bastrop and Monroe, La. Monroe is in WRPA 5; however, it is just across the planning area boundary, and about half of its cone of depression is in WRPA 6.

The postulated conditions upon which ground water availability estimates were made for this study have been exceeded in the Monroe-Bastrop area. About 90 percent of the total Sparta pumpage in WRPA 6 is in the Bastrop area. The potentiometric surface in the part of WRPA 6 where the Sparta contains fresh water in Arkansas has not been seriously affected by large withdrawals elsewhere, and this area still has good potential for future development.

Withdrawals from the Cockfield Formation are small; therefore, water levels remain relatively unaffected. The effect of future large withdrawals could be drastic in areas where the sands are thin, and the possibility of local dewatering exists. Even where the sands are thick, the low permeabilities require wide well spacing for large supplies. Any significant development of the Cockfield should be accompanied by careful planning.

In spite of the large withdrawals from the Mississippi River Valley alluvial aquifer, the effects on the potentiometric surface are only local. Seasonal recovery of water levels has not reflected a declining trend, and the aquifer has a large potential.



WRPA 7

W R P A 7

INTRODUCTION

WRPA 7, an area covering about 6,574 square miles and representing approximately 6.4 percent of the total area of the Lower Mississippi Region, lies totally within the State of Mississippi. About 146 square miles of the area are covered with water, and the remaining 6,428 square miles are land. The area is bounded on the west by the Mississippi River, on the east by the western edge of the Pearl River watershed, on the north by the Big Black River Basin's northern boundary, and on the south by the Buffalo River watershed boundary. The length of the area is about six times its width, thereby constituting a long, narrow basin. Figure 324 shows the WRPA boundaries, stream patterns, State lines, major cities, and other pertinent features of the area.

The streams originating in WRPA 7 averaged about 16 inches of runoff per year, or about 7,740 c.f.s. during the past 30 years. The maximum annual runoff for the area was about one and three-fourths times the average annual runoff, and the minimum was about one-third of the average annual runoff.

One of the principal streams in WRPA 7 is the Big Black River. The c.f.s. mean annual flow at its mouth averages about 3,900 c.f.s., or about 15.5 inches of runoff per year. This constitutes approximately 50 percent of the flows for the entire WRPA. The main channel of the river ranges in width from 90 feet in the headwater areas above Kilmichael, Miss., to over 250 feet in the Mississippi River backwater areas around Bovina, Miss. Average bank heights along the Big Black River range from 15 to 25 feet above the normal low water plane. Stream gradients for the river system vary from less than 1 foot per mile in the lower reaches of the main stem to over 2.5 feet per mile in the upper tributaries of the river.

The Big Black River rises in Webster County, Miss., and flows about 270 miles in a southwesterly direction to its confluence with the Mississippi River approximately 27 miles below Vicksburg, Miss. (mile 408.5 AHP 1/ of the Mississippi River). The basin is about 155 miles in length and averages about 22 miles in width, thus constituting a long, narrow basin with a total drainage area of about 3,400 square miles (52 percent of WRPA 7). The terrain and configuration of the Big Black River Basin are such that no appreciable amount of the total drainage area is controlled by any single tributary. Numerous small tributaries enter the main channel at fairly even intervals throughout its length. These tributaries, few of which are over 20 miles in length, have their

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1/ AHP - Above head of passes.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

MEAN ANNUAL RUNOFF IN INCHES

WRPA 7

FIGURE 324

source in the hill areas and carry a rapid runoff from drainage areas which vary from 6 to 200 square miles. Most of the tributaries located in the upper half of the Big Black Basin are perennial, whereas streams in the lower half of the basin are intermittent. During dry periods, two-thirds of the flow in the main stem originates from the numerous perennial streams in the upper reaches.

The valleys in the hill area of the Big Black Basin range in width from 1/2 to 3-1/2 miles from hill line to hill line, with an average width of about 2 miles. Bottom lands along the main stem of the river comprise about one-tenth of the total drainage area, and are subject to headwater flooding from the hill areas upstream. In addition, the lower 60 miles of the Big Black River floodplain are subject to backwater flooding from the Mississippi River. Portions of the floodplain are characterized by an upper and lower floodplain. The lower floodplain consists of the area adjacent to the river that is relatively narrow, flat, and wooded, and is subject to overflow about two or three times annually. The remaining area between the low lying bottom land and the hill line rise to a higher elevation, creating the upper floodplain which is flooded less frequently. Land subject to overflow comprises about 27 percent of the basin, including land in the upland watersheds and along the main stem.

The topography of the Big Black Basin is characterized by belted layers of geologic deposits and ranges from rolling to hilly land. Land surface elevations vary from about elevation 60 at the confluence of the Big Black and Mississippi Rivers to above elevation 500 along the eastern edge of the basin. The highest and most rugged terrain is found in the upper reaches of the eastern tributaries of the Big Black River Basin.

Another major stream in WRPA 7 is the Homochitto River. It contributes a mean annual flow of approximately 1,500 c.f.s., or about 19 percent of the total mean flow for the WRPA. The mean annual runoff for the Homochitto Basin is 17.7 inches per year, which is slightly above the average for the entire WRPA. The stream gradients vary from about 3.6 feet per mile in the lower reaches to over 9 feet per mile in the upper reaches.

The Homochitto River rises near Brookhaven, Miss., and flows in a southwestward direction approximately 80 miles to enter the Mississippi River about 22 miles below Natchez, Miss. The total drainage area of the Homochitto River is approximately 1,150 square miles, most of which is hilly cutover timberland. Up approximately to mile 30 on the Homochitto River, the floodplain averages slightly more than 2 miles in width. The stream enters the floodplain of the Mississippi River at about mile 7.

Topography of the Homochitto Basin is characterized by hilly

terrain throughout the entire area. Land surface elevations vary from elevation 50 along the Mississippi River floodplain to above elevation 500 in the upper reaches of the river.

Other major streams in WRPA 7 are the Buffalo River, St. Catherine Creek, Coles Creek, and Bayou Pierre. Drainage areas at the mouths of these streams are 420, 102, 430, and 1,073 square miles, respectively. Stream length for the Buffalo River is approximately 62 miles and for Bayou Pierre is about 82 miles. Average channel slope for the Buffalo River is approximately 9 to 10 feet per mile. The slope of the main channel of Bayou Pierre ranges from 4 to 7 feet per mile.

The topography of these areas is very similar to that of the Big Black and Homochitto River Basins. Land elevations vary from about elevation 60 along the Mississippi River floodplain to about elevation 400 in the upper part of the Buffalo River Basin, and about elevation 500 in the upper reaches of the Bayou Pierre Basin.

Bayou Pierre has a mean annual flow of about 1,200 c.f.s., which comprises about 16 percent of the total mean flow for the WRPA. The mean annual flows for the Buffalo River, Coles Creek, and St. Catherine Creek are about 575, 475, and 110 c.f.s., respectively. These three streams comprise the remaining 15 percent of the total flows for WRPA 7.

SURFACE WATER

A major part of the streamflow generated within WRPA 7 originates as surface runoff from the hill areas of the Big Black, Homochitto, and Bayou Pierre Basins. During the dry seasons, about two-thirds of the flow of the Big Black River is generated in the perennial streams of the upper one-half of the basin. Many of the streams in the lower part of the basin are intermittent; however, few problems have arisen over water use in the area. This is mainly due to the area being neither heavily populated nor industrialized and to the abundant supply of ground water in the area.

Quantity

The average discharge of streams originating in WRPA 7 totals about 7,740 c.f.s. per year. This averages about 1.18 c.f.s. per square mile, which is an average figure as compared with that for the rest of the region.

Present Utilization

Withdrawals from surface water sources in WRPA 7 during 1970 were equivalent to only about 0.25 percent of the mean annual flow generated within the area. Surface water withdrawals constituted less than 7 percent (12 c.f.s.) of the total water withdrawn in the area, with the remainder coming from ground water sources (about 170 c.f.s.). Major surface water withdrawals were for purposes of fish and wildlife enhancement (less than 4 c.f.s.) and for agricultural uses other than irrigation (about 3.7 c.f.s.), which comprised 33 and 31 percent, respectively, of the total surface water withdrawn in the area. No surface water was withdrawn for municipal use or power production and very little was used by industry. Recreation is a popular pastime throughout the area, and most lakes and streams are used for fishing, boating, and related water sports.

The major portion of the total water withdrawn in WRPA 7 during 1970 was from ground water sources. Almost all of the water used for municipal and industrial purposes in the area was withdrawn from ground water. Industry withdrew an average of about 113 c.f.s., or 65 percent of the total ground water withdrawal. Ground water withdrawals for municipal use totaled about 19 c.f.s.

Of the total surface and ground water withdrawals in the area during 1970, about 63 c.f.s., or 34 percent, was consumed. The remaining 119 c.f.s. was released and returned to streamflow. This resulted in a net increase to streamflow in the area of 107 c.f.s. The major consumptions of water were for irrigation (10.5 c.f.s.), industrial purposes

(9.3 c.f.s.), commercial fishing (8.2 c.f.s.), and rural domestic purposes (8.1 c.f.s.).

Additional information on the withdrawals of ground and surface water in WRPA 7 during 1970 is given in table 15 of the Regional Summary. This table also presents pertinent data on the consumption of water for various purposes in this WRPA and each of the other areas in the Lower Mississippi Region.

Stream Management

Efficient stream management in an area benefits all the various users of the area's water resources. Stream management in WRPA 7 consists mainly of changes in stream systems such as the construction of dams for impounding water and reducing flood flows, diversions of surface water for irrigation, the development of levees, and channel improvements. Some of these changes were begun before records of streamflow were obtained in the area, and others have been made so gradually that, even if the effects could be isolated, it would require many subsequent years of record to define them.

Impoundments. There are no reservoirs in WRPA 7 which have a total capacity of 5,000 acre-feet or more; however, the Soil Conservation Service to date has constructed 21 flood-detention structures in the Big Black Basin. The total detention storage for these structures is about 8,795 acre-feet. The emptying period required is about two weeks if the reservoirs are filled to full pool.

Diversions. Most of the water used in WRPA 7 is obtained from ground water sources. Only a small part of the water is obtained through diversion of streamflow. In the Big Black River Basin, a small amount of surface water is diverted for supplemental irrigation of row crops. Additionally, very small amounts are diverted for domestic and industrial purposes, since the area is neither heavily populated nor industrialized. In general, the adequacy of surface water, ground water, and rainfall relative to the present demands precludes the need for close legal constraints on surface water diversion.

Channel modification. In WRPA 7, channel modification has taken place on the Big Black and Homochitto Rivers. In 1939, over 300 miles of the main channel of the Big Black River were improved by clearing and snagging and construction of 43 cutoffs. This work lowered peak stages and permitted faster runoff of floodwater. Additional channel clearing and snagging on 14 tributaries of the Big Black River were completed in 1941. About 60 miles of channel improvements and construction of numerous grade-control structures have been completed on many of the small hill streams in the upstream watersheds.

About 20 miles of clearing and snagging, 1.5 miles of channel enlargement, and 15 cutoffs were made on the Homochitto River during the

period 1938 to 1941. The work resulted in lowering of stages of lesser floods, but had little effect on major floods. Additional flood-control works on the lower 35 miles of the river were completed in 1952 and consisted of the excavation of cutoffs and the clearing and snagging of the main channel.

Channel improvement on the Buffalo River was authorized in 1936. However, due to insufficient justification and lack of local interest, this project has been deferred indefinitely.

Streamflow

The periods used for streamflow studies in this report vary due to the availability of discharge data at the selected sites. At appropriate stations, the period of record was modified to reflect changes in the discharge characteristics at the site due to upstream regulation, channel improvements, etc. A summary of the controlling agency, the drainage areas, periods of record, gage datum, and other pertinent data for each of these stations is given in Table 208.

Table 208 - Streamflow Summary for Selected Sites, WRPA 7

Stream	Station	Agency	Station No.	Gage Datum (feet m.s.l.)	Drainage Area (square miles)	Period of Record 1/	Annual Flows (c.f.s.) Mean	Maximum	Minimum	Momentary Maximum Flow (c.f.s.)	Daily Minimum Flow (c.f.s.)	Stage Data (feet, m.s.l.) Highest	Lowest
Big Black River	Pickens, Miss.	USGS	7-2895	196.26	1,460	1937-67	1,774	3,527	569	49,400	27	218.5	197.6
Big Black River	Bovina, Miss	USGS	7-2900	84.93	2,810	1936-69	3,345	6,713	794	63,500	65	125.4	90.9
Bayou Pierre	Willows, Miss.	USGS	7-2906.5	82.34	653	1961-69	720	1,194	319	31,300	20	109.7	84.6
Homochitto River	Eddiceton, Miss.	USGS	7-2910	217.22	180	1939-69	246	414	92	30,900	26	234.0	217.7
Homochitto River	Rosetta, Miss.	USGS	7-2925	94.39	750	1952-67	991	1,690	348	141,000	129	130.4	104.4
Buffalo River	Woodville, Miss.	USGS	7-2950	94.52	182	1942-69	250	466	79	44,800	16	114.7	97.5

1/ This period of record applies to annual flows and not necessarily to momentary flows or stage data; however, the momentary flows and stage data occurred under conditions similar to that which existed during the period of record indicated.

Measurement facilities. The six sites for which streamflow data are shown in this report are considered representative of the various drainage and hydrologic conditions existing in WRPA 7. The locations of these selected sites are shown in Figure 324, a map of mean annual runoff in inches for the WRPA, and are identified by U. S. Geological Survey station numbers.

Average discharge for WRPA 7. Figure 324 is a map of isopleths showing the mean annual runoff for WRPA 7. Figure 325 is a graphical representation of the average monthly discharge generated within the area. The figure also presents the maximum, minimum, 20 percent and 80 percent duration flows by months for WRPA 7. This discharge consists of the total drainage which flows into the Mississippi River from the Big Black River, Bayou Pierre, St. Catherine Creek, Coles Creek, Homochitto River, and Buffalo River watersheds.

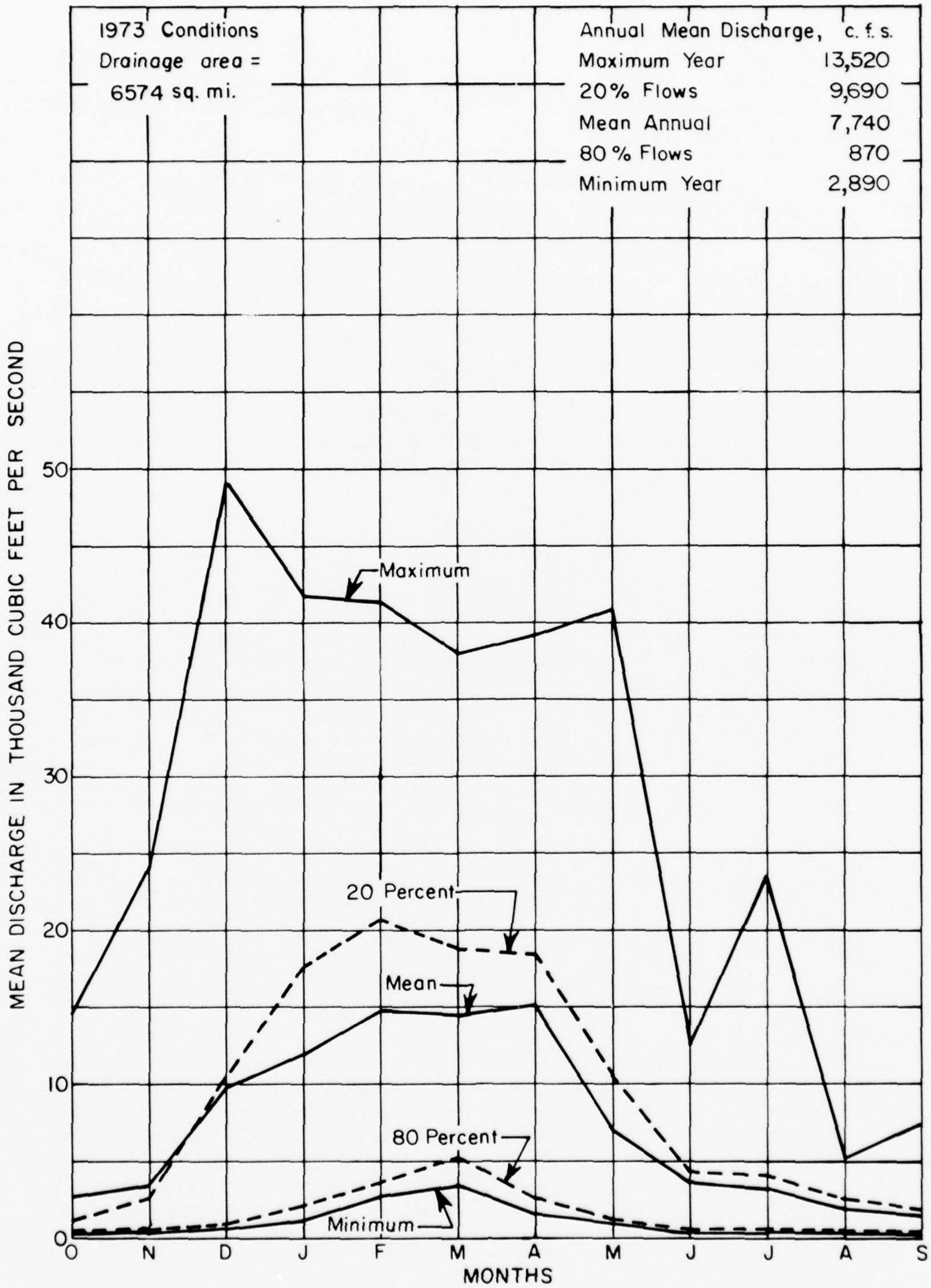


Figure 325 Monthly discharge from WRPA 7

Average discharge for selected stations. Observed mean discharge by months for each of the selected gaging stations shown in table 208 (Streamflow Summary) are given in tables 209-214. These flows reflect regulation and water use under 1973 levels of development.

Peak flow frequency curves for each study station are shown in figures 326-331. These curves are a reflection of the annual peak discharge at each site. They were computed using the log-Pearson Type III procedure [6].

Low flow frequency curves for selected stations in WRPA 7 are shown in figures 332-336. These curves represent the lowest average flow for periods of 7, 30, 60, and 90 consecutive days. Low flow frequency curves are used in determining the dependable supply of surface water without storage in a stream.

Duration curves for daily flows are presented in figures 337-342. These curves show the percent of time that specified discharges were equaled or exceeded at the site during a given period. The curves indicate flow characteristics of the stream throughout the entire range of discharges without regard to the sequence of occurrence. The maximum daily flows are listed on the graphs because of space limitations.

A comparison of the flow in c.f.s. per square mile for the gaging stations in WRPA 7 shows that the Bayou Pierre (figure 339) and Buffalo River (figure 342) duration curves were steeper than the other curves. This is an indication that flow in these streams is more variable than the Big Black and Homochitto River flows.

Dependable yield data at each of the gaging stations are given in tables 215-219. These tables show the lowest mean flows for one to ten consecutive years of the period of record. The relationship of these means to the period of record mean is also given. The minimum yearly flow for the stations in this WRPA ranges between 24 and 37 percent and averages 32 percent of the mean flow. During the 10 consecutive years of lowest discharge, the yield varied from 84 to 99 percent of the mean. For stations with periods of record less than 10 years, no dependable yield data were computed.

Flow Velocities

Time of travel studies have been made on the Big Black and Homochitto Rivers in WRPA 7. Travel times were measured from dye tracings through subreaches of each stream during conditions of low and intermediate flow. These data were used to compute the average velocity of flow in each subreach, as shown in figure 52.

The velocities in figure 52 correspond to specific discharges, and since velocity is a function of discharge, the user should be cautious in applying these data to any other condition of flow. In general,

stream velocities vary with discharge so that at higher discharges, greater velocities would be expected. The velocities represent the average velocity through a subreach; however, velocities can vary from point to point within a subreach. The discharges shown in figure 52 for streams in WRPA 7 are for flows which are equaled or exceeded 70 to 85 percent of the time.

River Profile

A profile of the approximate bottom elevation, top bank elevation, and 50 percent duration flow line of the Big Black River is shown in figure 343. This profile was constructed from topographic maps and data from available reports. The 50 percent duration flow line was plotted from data at various gaging stations along the river. No profiles were available for any of the other streams in WRPA 7.

Quality

Chemical analyses of samples collected at 12 sites in WRPA 7 from selected streams are representative of the dissolved constituents in the water from streams draining various aquifers. The dissolved-solids content ranged from 32 to 256 mg/1.

During low flow periods, the dissolved-solids content of water in the lower part of the area may be more than twice as much as it is upstream from Pickens, Miss. (table 220). Hardness is twice as high in the Big Black River downstream from Pickens (about 50 mg/1) as upstream (about 25 mg/1).

The first of two reasons for higher dissolved solids and hardness in the lower part of the Big Black River at low flow is that there are more sources of pollution in the lower end. In addition to municipal and industrial waste, there is considerable oil field waste at several places below Pickens. Some of the tributary streams also show pollution from oil fields (table 220).

The second reason for increased dissolved solids and hardness in the Big Black River below Pickens is geologic. The reach from Pickens to below Bovina traverses outcrops of the Jackson (Yazoo clay) and Vicksburg Groups, which are much more calcareous than the geologic units which crop out above Pickens. The calcareous mantle of loess in the lower part of the river could also contribute to the dissolved-solids content and hardness of shallow ground water and, therefore, to that of surface water base flow. However, the Jackson, Vicksburg, and loess deposits contribute little or no water to tributary streams during dry periods. Water in the alluvium is hard to very hard (150-350 mg/1) and moderately mineralized (200-500 mg/1 dissolved solids). During very dry periods, nearly half the flow in the lower end of the river may be alluvial water.

Except for water in the alluvium, there is generally no great difference in the quality of shallow water in the various aquifers--as is demonstrated by relating quality of water in streams at low flow (discharged ground water) to the geologic units traversed by the streams. Dissolved-solids content of water from streams draining from the Winona Sand is higher than from streams draining from the Sparta Sand. Most of the water from Hays Creek near Vaiden at low flow is from the Winona Sand, and most of the water from Apookta Creek is from the Sparta Sand. The specific conductance readings of 197 from Hays Creek and of less than 50 from Apookta Creek seem to accurately reflect the quality of water in the two aquifers.

Table 209 - Observed Mean Discharge in c.f.s., Sta 72895.00, Big Black River at Pickens, Miss., 1937-1967

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1937	53	71	338	3,940	2,741	2,506	1,354	1,146	530	157	464	744	1,170
1938	109	1,201	956	2,603	1,995	2,519	3,792	588	995	1,054	634	133	1,381
1939	65	167	188	1,446	3,867	1,749	2,953	634	2,172	828	240	63	1,197
1940	55	62	380	593	4,925	3,018	4,607	1,100	385	8,281	923	249	2,048
1941	75	1,393	5,603	1,612	1,525	2,603	971	235	193	1,321	732	218	1,373
1942	237	1,588	2,414	1,153	2,084	3,635	799	772	250	257	372	148	1,142
1943	69	137	947	1,967	859	2,555	1,276	460	177	135	70	237	740
1944	47	288	167	1,224	3,596	8,005	6,005	4,195	228	157	706	125	2,061
1945	74	177	655	2,692	6,285	8,759	2,884	1,119	617	350	409	112	2,011
1946	177	231	888	8,208	10,509	3,751	2,058	2,226	1,826	1,373	835	139	2,685
1947	106	2,175	1,567	9,913	1,992	3,294	7,011	1,426	2,348	1,074	184	98	2,599
1948	81	983	1,689	1,658	9,431	6,431	3,712	303	384	365	414	140	2,132
1949	113	2,654	5,548	12,643	6,558	3,351	3,747	4,019	2,454	422	310	513	3,527
1950	229	303	350	5,784	7,211	5,568	705	1,128	1,829	771	768	2,206	2,237
1951	1,128	1,301	1,557	5,011	9,034	8,710	7,202	1,201	628	388	126	149	3,036
1952	103	240	3,176	2,153	2,774	3,146	1,909	580	209	105	90	63	1,212
1953	50	113	203	1,197	3,948	3,688	1,199	5,521	212	932	179	103	1,445
1954	58	66	385	1,802	1,630	1,215	1,115	3,795	237	122	56	40	876
1955	44	191	243	1,315	2,539	3,248	5,819	577	328	466	214	56	1,253
1956	66	190	198	168	7,330	4,608	5,041	965	181	138	94	49	1,585
1957	202	202	2,880	2,181	6,269	2,775	2,645	239	2,000	1,659	284	433	1,814
1958	929	7,878	3,446	2,265	2,554	3,050	3,308	7,522	681	868	553	927	2,831
1959	423	598	335	1,262	4,659	2,405	3,796	969	983	902	441	561	1,444
1960	516	515	3,072	3,447	6,233	6,376	1,417	1,520	186	103	293	172	1,987
1961	155	208	339	716	3,430	6,455	5,014	523	711	1,589	374	183	1,641
1962	107	3,296	13,224	7,078	4,037	5,466	3,664	677	651	147	163	159	3,222
1963	238	234	247	542	1,000	1,896	362	282	211	1,304	395	128	569
1964	68	136	912	1,873	2,183	5,884	6,611	2,610	228	531	831	231	1,841
1965	477	329	1,849	1,286	7,956	4,766	3,639	263	163	308	331	155	1,793
1966	138	96	155	992	6,960	1,288	2,550	3,576	274	221	125	277	1,387
1967	117	232	310	349	1,401	1,136	374	2,742	438	1,160	676	189	760
Mean	203	879	1,749	2,873	4,435	3,995	3,146	1,706	732	886	396	290	1,774

Table 210 - Observed Mean Discharge in c.f.s., Sta 72900.00, Big Black River near Bovina, Miss., 1936-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1936	--	--	--	--	--	--	3,256	1,961	212	317	294	180	--
1937	99	148	925	8,907	7,780	4,550	3,774	1,861	915	274	586	1,142	3,105
1938	238	840	951	4,607	2,853	5,140	11,038	1,379	934	1,024	1,230	300	2,544
1939	122	282	306	2,596	7,485	4,625	4,099	807	2,657	1,493	526	164	2,096
1940	122	103	596	920	7,926	4,973	9,454	4,449	673	13,734	2,060	449	3,788
1941	150	2,734	10,536	4,681	3,883	6,179	2,995	443	314	2,039	1,308	465	2,977
1942	277	2,036	3,668	2,378	3,324	8,596	1,966	1,590	423	518	1,930	503	2,267
1943	243	377	1,499	4,929	1,422	4,805	4,441	504	500	305	121	418	1,630
1944	95	560	245	1,839	4,160	13,393	15,019	5,685	556	211	862	197	3,568
1945	102	291	995	4,942	8,961	14,123	6,485	2,255	3,035	1,062	1,024	198	3,622
1946	795	282	1,183	16,488	20,142	6,637	4,152	4,918	5,878	3,908	1,827	246	5,537
1947	173	3,612	2,113	17,124	4,035	5,949	13,093	3,432	2,816	1,273	328	324	4,522
1948	118	1,629	2,931	2,062	14,854	12,593	6,222	580	568	462	1,156	207	3,615
1949	192	4,668	11,167	21,348	13,687	7,192	8,003	7,060	3,986	1,572	1,037	750	6,713
1950	395	456	425	8,790	14,099	10,182	1,957	3,581	3,101	1,526	2,060	2,428	4,083
1951	1,526	1,866	2,912	8,061	15,675	10,234	17,567	2,484	803	739	269	206	5,195
1952	179	293	2,436	3,181	3,944	4,377	2,800	1,294	461	172	163	106	1,617
1953	83	150	463	2,191	4,607	8,974	2,185	15,466	424	1,110	359	161	3,014
1954	99	109	544	2,644	3,017	1,959	1,693	8,051	406	226	123	115	1,582
1955	79	291	213	2,182	4,552	3,955	12,248	1,046	537	1,189	539	152	2,248
1956	120	274	386	216	11,329	10,745	11,280	2,578	949	229	232	117	3,204
1957	286	290	4,213	3,142	8,134	5,260	6,223	602	2,917	3,889	540	746	3,020
1958	1,134	11,054	7,874	4,870	5,220	6,693	3,772	17,727	2,234	1,202	1,086	1,396	5,355
1959	956	1,219	501	2,142	7,635	4,695	4,706	3,452	1,747	1,330	713	818	2,492
1960	808	563	4,467	6,842	10,097	11,896	1,856	3,038	401	206	1,696	555	3,535
1961	389	282	597	2,011	4,596	14,271	10,105	989	2,847	2,339	673	513	3,301
1962	186	4,121	25,730	11,643	8,535	9,277	10,514	1,836	1,116	271	255	227	6,142
1963	295	278	344	760	1,725	2,470	559	398	306	1,621	572	204	794
1964	102	233	1,197	2,728	2,998	11,541	12,270	5,580	485	1,422	1,020	526	3,341
1965	1,169	802	3,886	3,219	11,080	9,064	5,838	430	414	422	531	259	3,092
1966	327	147	296	2,260	14,703	2,617	4,538	8,961	976	333	492	520	3,014
1967	303	285	601	932	2,610	1,959	803	4,482	2,779	1,968	977	374	1,505
1968	207	230	12,137	15,454	2,339	4,263	7,704	9,801	2,014	654	583	696	4,673
1969	253	445	5,264	2,907	5,876	4,967	16,060	1,386	382	295	274	290	3,199
Mean	352	1,240	3,381	5,421	7,374	7,216	6,725	3,826	1,434	1,451	807	469	3,345

Table 211 - Observed Mean Discharge in c.f.s., Sta 72906.50, Bayou Pierre near Willows, Miss., 1961-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1961	--	--	--	--	--	--	--	--	858	687	235	192	--
1962	73	1,357	3,351	3,189	911	565	1,782	399	522	75	72	68	1,194
1963	94	105	·171	978	823	961	133	60	151	170	134	56	319
1964	26	66	149	682	366	3,060	3,926	205	238	899	147	63	818
1965	1,885	1,683	2,605	878	2,801	2,207	351	100	161	102	126	412	1,109
1966	155	71	149	1,460	3,428	482	2,539	760	126	81	112	155	793
1967	68	228	186	238	561	239	192	1,595	587	147	260	188	374
1968	89	69	1,318	1,726	412	767	1,098	789	144	170	189	55	568
1969	32	82	936	214	777	1,727	2,705	307	64	94	38	66	586
Mean	302	457	1,108	1,170	1,259	1,251	1,590	526	316	269	145	139	720

Table 212 - Observed Mean Discharge in c.f.s., Sta 72910.00, Homochitto River at Eddiceton, Miss., 1939-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1939	32	38	79	470	811	1,119	219	128	375	55	71	41	286
1940	42	38	100	135	501	337	986	172	160	781	72	42	280
1941	33	80	1,196	182	107	471	467	201	66	135	53	54	253
1942	69	104	511	231	258	549	417	382	80	62	160	119	245
1943	63	51	342	157	352	670	305	73	55	73	37	45	185
1944	36	45	63	279	486	1,059	213	131	48	37	80	46	210
1945	39	54	123	267	807	364	324	115	135	61	70	42	200
1946	88	59	156	572	944	371	85	351	174	267	127	49	270
1947	38	321	175	1,268	106	761	1,569	155	95	48	50	113	391
1948	48	140	277	469	498	700	231	67	43	55	110	50	223
1949	44	655	210	684	771	1,061	251	166	175	315	66	58	371
1950	81	54	73	968	850	833	436	1,058	190	272	97	57	414
1951	55	56	101	261	571	459	193	63	132	73	45	83	174
1952	46	48	291	160	214	214	167	164	52	54	56	37	125
1953	31	44	145	212	882	584	625	1,818	93	83	66	46	385
1954	44	46	81	106	71	162	169	232	59	44	35	62	92
1955	40	42	146	206	1,002	100	924	75	72	159	153	42	246
1956	45	55	80	67	839	447	109	52	70	43	54	33	157
1957	36	42	174	54	72	263	406	66	218	103	79	182	141
1958	220	742	352	363	320	719	289	135	448	125	60	100	322
1959	48	72	69	249	508	201	249	92	229	114	67	62	163
1960	109	148	789	440	521	515	111	182	49	54	292	99	275
1961	49	48	114	616	788	1,400	306	70	146	311	104	54	333
1962	44	388	1,063	1,076	264	405	420	139	169	56	47	56	344
1963	56	56	64	513	218	414	64	50	62	84	59	42	140
1964	35	40	91	221	228	908	935	182	105	429	94	46	276
1965	765	196	660	167	639	526	128	66	67	51	73	302	303
1966	90	49	82	514	1,149	215	968	164	60	52	52	51	287
1967	60	167	76	91	247	106	93	457	175	117	77	61	143
1968	55	45	497	468	148	217	285	246	90	115	101	56	193
1969	37	59	307	95	234	597	839	163	49	79	42	41	211
Mean	79	128	273	372	496	540	412	239	127	138	82	70	246

Table 213 - Observed Mean Discharge in c.f.s., Sta 72925.00, Homochitto River at Rosetta, Miss., 1952-1967

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1952	194	286	953	669	894	827	711	787	247	263	244	170	520
1953	141	234	651	953	3,756	2,747	2,520	7,650	508	510	385	232	1,690
1954	201	239	335	370	363	491	466	730	265	223	166	331	348
1955	196	210	426	620	4,025	559	3,837	408	299	514	601	230	993
1956	178	258	375	283	3,695	2,656	604	296	366	236	256	158	780
1957	173	218	994	255	370	951	1,498	420	1,224	695	461	1,273	710
1958	1,379	3,010	1,641	1,632	1,168	2,174	1,239	809	1,525	870	348	843	1,386
1959	305	375	348	1,018	2,412	817	1,009	680	963	615	386	380	775
1960	361	692	2,573	1,416	1,449	1,612	516	516	242	242	875	358	904
1961	249	267	425	2,971	3,168	6,206	1,425	478	961	1,204	451	361	1,513
1962	265	1,679	5,344	3,784	1,129	1,357	2,179	448	772	431	301	324	1,501
1963	265	295	430	2,319	938	1,458	313	247	310	361	254	213	616
1964	161	202	539	1,240	1,082	3,750	3,240	714	351	1,488	713	241	1,143
1965	3,855	584	1,777	638	2,211	1,826	556	316	272	311	376	1,175	1,158
1966	359	312	821	2,167	3,679	1,093	2,815	937	362	303	343	319	1,125
1967	378	688	351	567	862	518	805	1,913	809	659	381	343	689
Mean	541	596	1,123	1,306	1,950	1,815	1,483	1,084	592	557	408	434	991

Table 214 - Observed Mean Discharge in c.f.s., Sta 72950.00, Buffalo River near Woodville, Miss., 1942-1969

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1942	--	--	--	--	--	--	331	82	63	80	68	113	--
1943	100	47	317	202	625	1,076	299	70	182	46	31	97	319
1944	28	70	202	385	388	539	219	105	45	39	142	61	185
1945	52	218	380	446	633	185	402	193	306	138	74	38	255
1946	145	103	355	835	681	503	84	668	251	220	130	44	334
1947	65	686	137	1,172	156	848	704	153	265	45	55	115	366
1948	42	121	300	356	373	1,713	333	82	43	53	61	269	312
1949	52	1,008	864	559	687	926	566	343	110	232	180	71	466
1950	175	57	78	924	589	544	241	367	120	69	117	100	281
1951	53	55	124	282	436	418	476	68	465	127	55	39	216
1952	34	54	250	129	282	159	178	197	42	56	41	23	120
1953	20	48	166	171	697	702	327	1,928	92	118	99	32	366
1954	26	39	108	101	71	170	104	134	48	46	27	82	79
1955	37	33	101	157	982	84	1,180	107	57	549	294	36	301
1956	28	51	145	64	682	909	168	50	184	49	56	29	201
1957	23	33	299	60	167	317	199	159	371	140	37	164	163
1958	235	794	418	447	340	375	382	155	346	244	109	697	378
1959	74	77	115	288	620	247	239	102	105	101	91	87	178
1960	64	106	484	265	235	200	89	94	43	37	154	42	150
1961	71	47	138	538	799	1,660	293	75	157	142	56	87	338
1962	33	458	767	687	188	128	389	86	214	46	52	45	257
1963	49	42	50	311	150	240	49	35	41	93	36	55	95
1964	19	34	122	379	240	912	441	107	63	311	137	39	233
1965	975	150	504	123	522	441	77	46	39	51	60	237	268
1966	37	87	231	442	1,144	223	505	136	53	47	48	68	251
1967	45	87	46	68	194	103	1,156	600	143	188	54	74	229
1968	37	35	513	227	132	170	115	195	74	68	64	48	139
1969	28	46	259	97	378	465	400	245	41	1,110	38	34	261
Mean	94	169	276	359	458	528	355	235	141	158	84	100	250

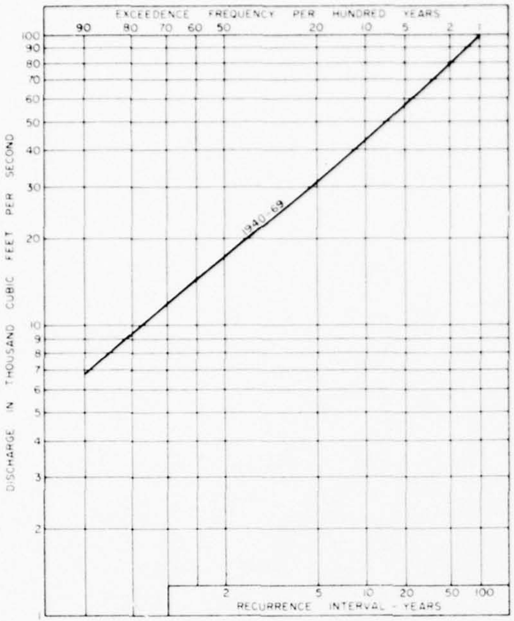


FIGURE 326 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-2895 BIG BLACK RIVER AT PICKENS, MISS.

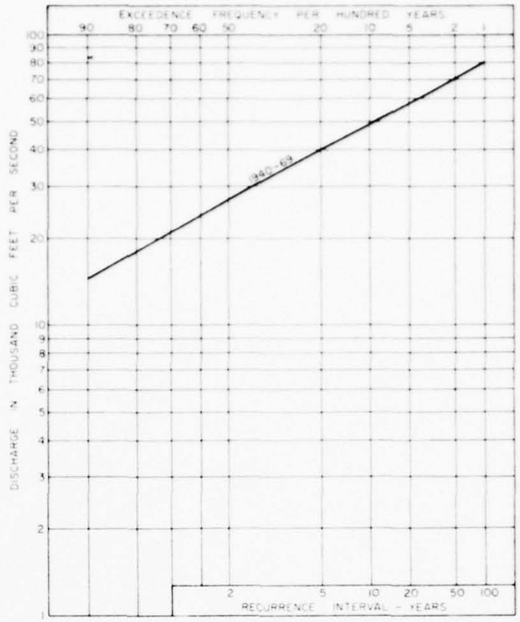


FIGURE 327 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-2900 BIG BLACK RIVER NEAR BOVINA, MISS.

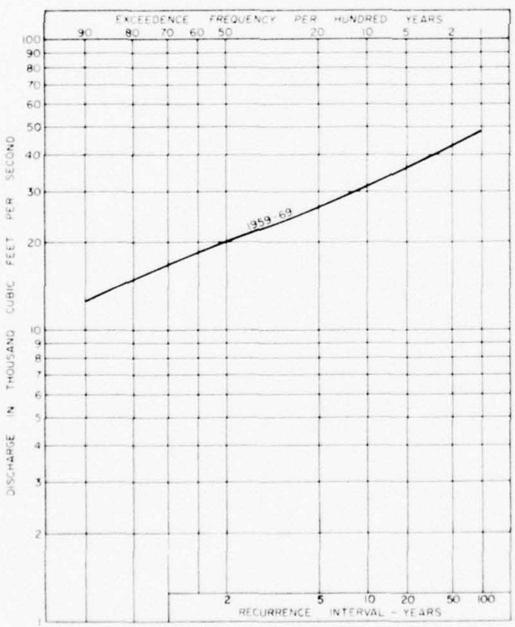


FIGURE 328 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-29065 BAYOU PIERRE NEAR WILLOWS, MISS.

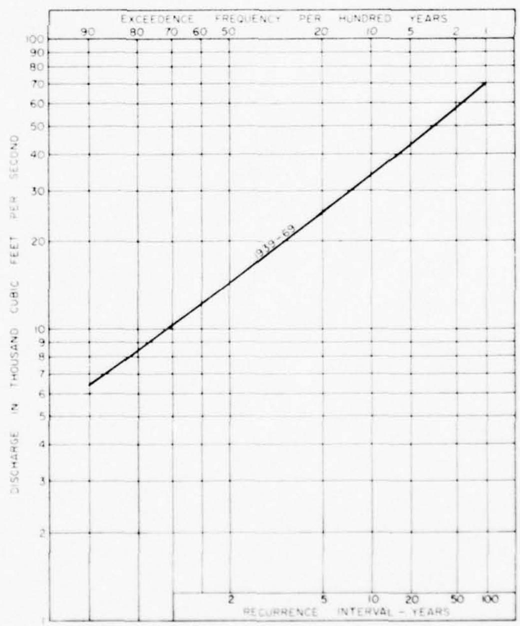


FIGURE 329 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-2910 HOMOCHITTO RIVER AT EDDICETON, MISS.

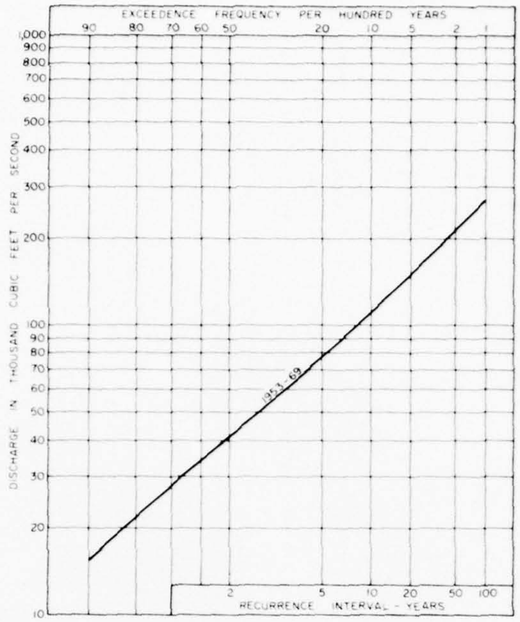


FIGURE 330 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-2925 HOMOCHITTO RIVER AT ROSETTA, MISS

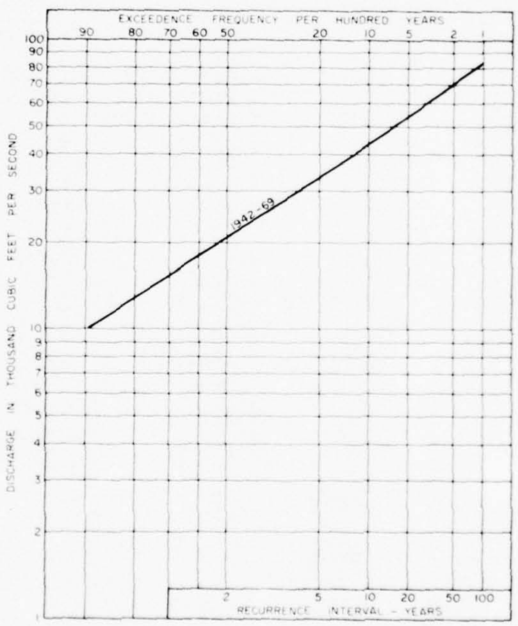


FIGURE 331 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-2950 BUFFALO RIVER NEAR WOODVILLE, MISS

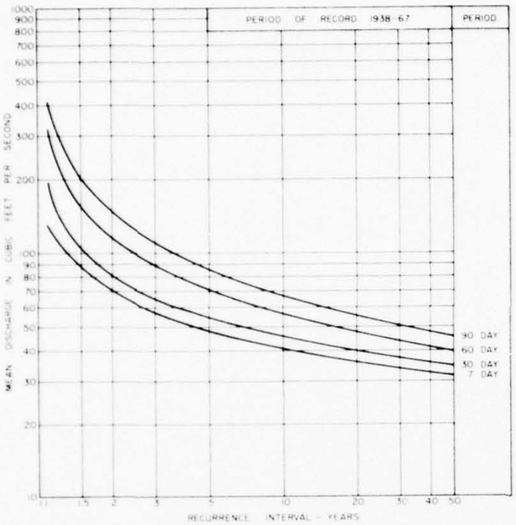


FIGURE 332 LOW FLOW FREQUENCY CURVES
7-2895 BIG BLACK RIVER AT PICKENS, MISS

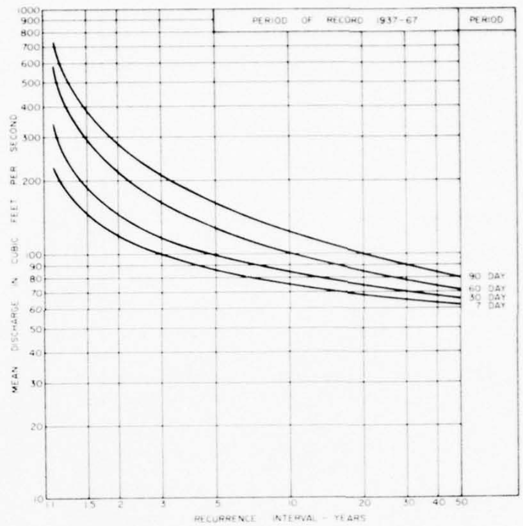


FIGURE 333 LOW FLOW FREQUENCY CURVES
7-2900 BIG BLACK RIVER AT BOVINA, MISS

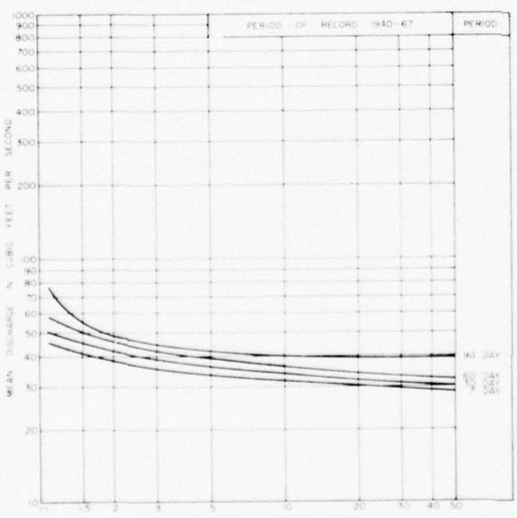


FIGURE 334 LOW FLOW FREQUENCY CURVES
7-2910 HOMOCHITTO RIVER AT EDDICETON, MISS

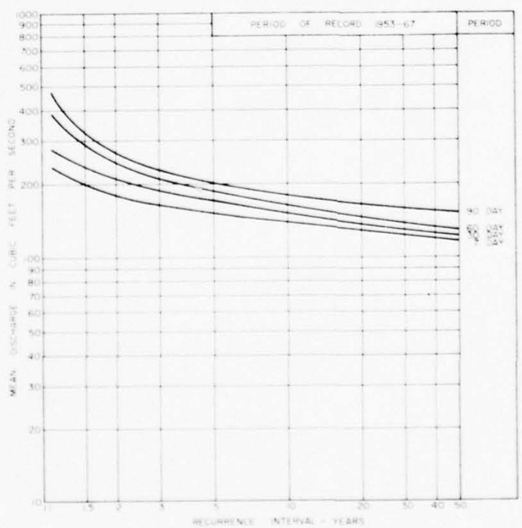


FIGURE 335 LOW FLOW FREQUENCY CURVES
7-2925 HOMOCHITTO RIVER AT ROSETTA, MISS

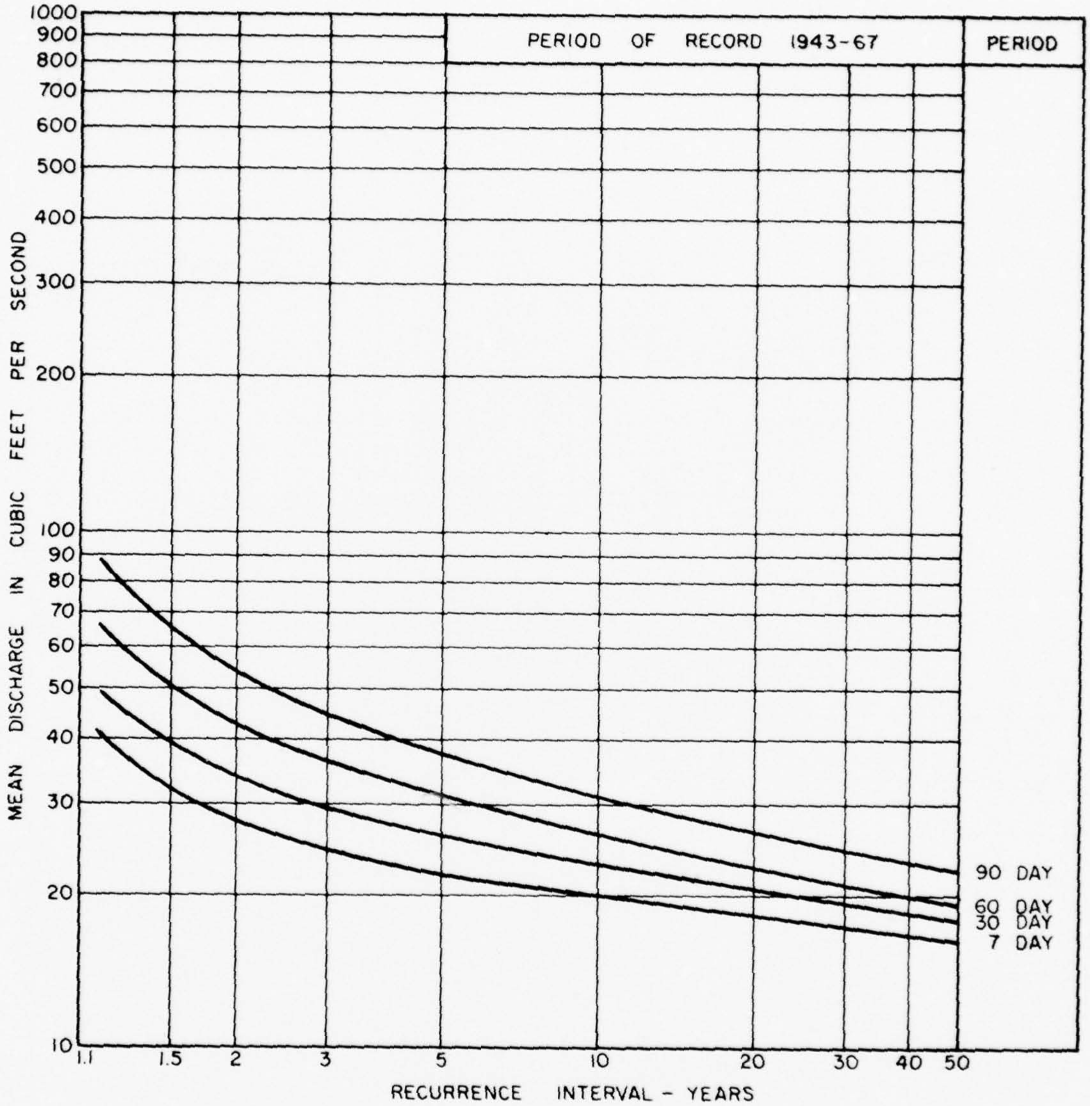


FIGURE 336 LOW FLOW FREQUENCY CURVES
7-2950 BUFFALO RIVER NEAR WOODVILLE, MISS.

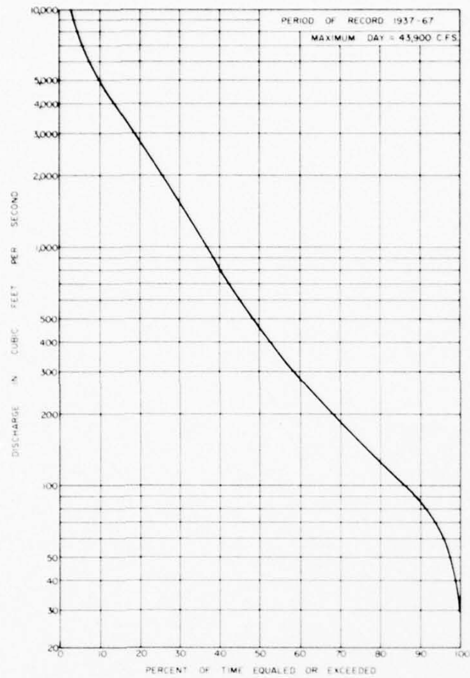


FIGURE 337 DURATION CURVE
7-2895 BIG BLACK RIVER AT PICKENS, MISS.

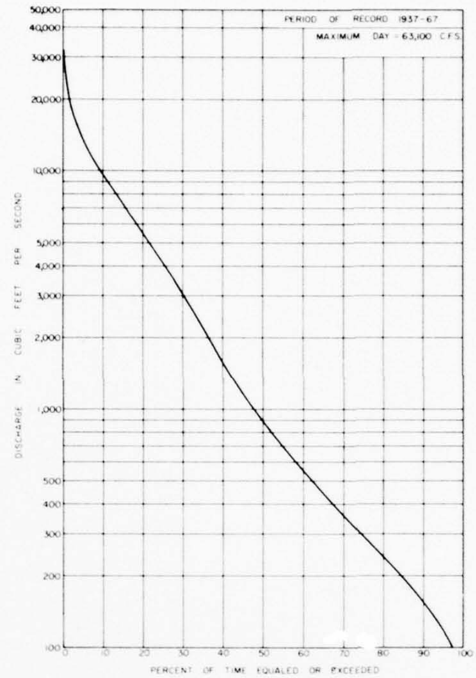


FIGURE 338 DURATION CURVE
7-2900 BIG BLACK RIVER NEAR BOVINA, MISS.

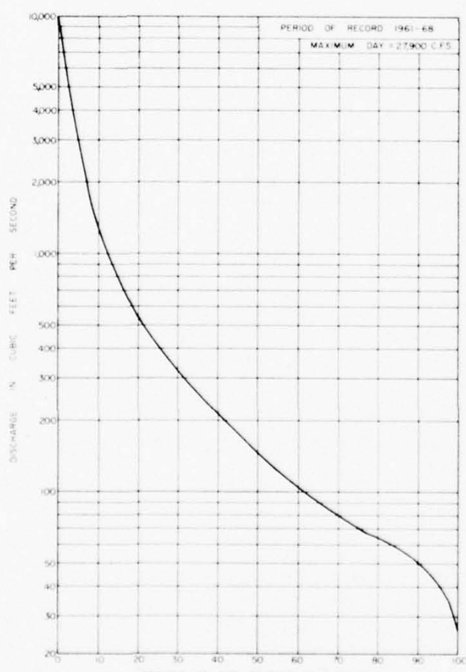


FIGURE 339 DURATION CURVE
7-2906.5 BAYOU PIERRE NEAR WILLOWS, MISS.

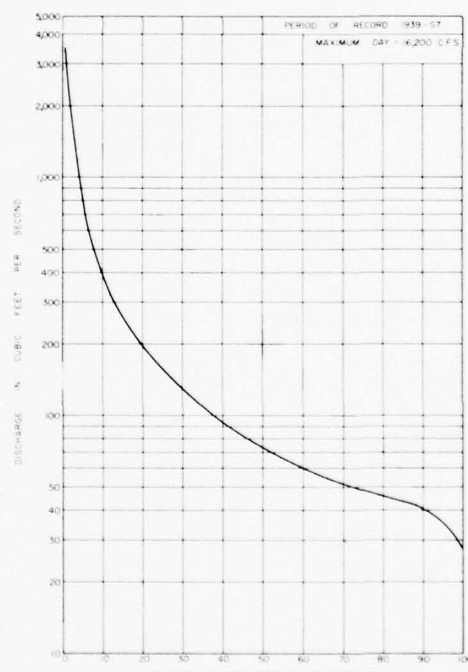


FIGURE 340 DURATION CURVE
7-2910 HOMOCHITTO RIVER AT EDDICETON, MISS.

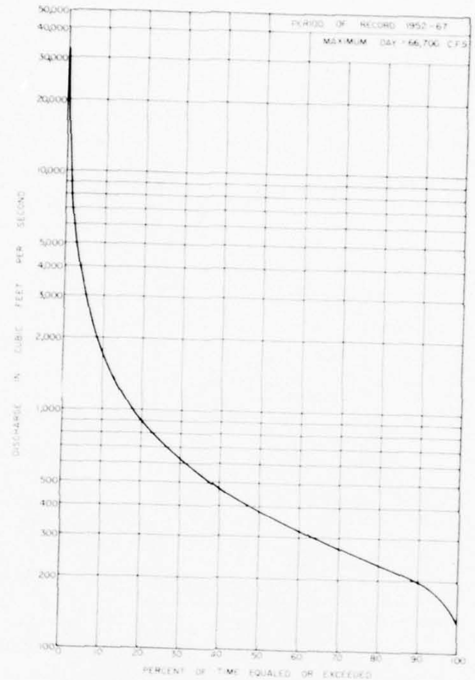


FIGURE 341 DURATION CURVE
7-2925 HOMOCHITTO RIVER AT ROSETTA, MISS.

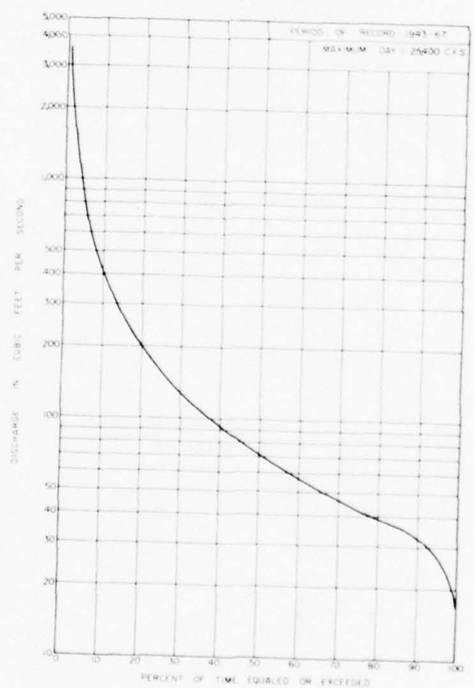


FIGURE 342 DURATION CURVE
7-2950 BUFFALO RIVER NEAR WOODVILLE, MISS.

Table 215 - Dependable Yield at Sta 72895.00, Big Black River at Pickens, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1937-1969 Mean
1	1963-1963	569	31.6
2	1942-1943	941	52.2
3	1941-1943	1,085	60.2
4	1952-1955	1,196	66.4
5	1963-1967	1,270	70.5
6	1938-1943	1,313	72.9
7	1937-1943	1,293	71.7
8	1937-1944	1,389	77.1
9	1937-1945	1,458	80.9
10	1937-1946	1,580	87.7
33	1937-1969	1,802	100.0

Table 216 - Dependable Yield at Sta 72900.00, Big Black River near Bovina, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1937-1969 Mean
1	1963-1963	794	23.7
2	1954-1955	1,915	57.2
3	1952-1954	2,071	61.9
4	1952-1955	2,115	63.2
5	1952-1956	2,333	69.7
6	1952-1957	2,447	73.2
7	1937-1943	2,629	78.6
8	1937-1944	2,746	82.1
9	1937-1945	2,844	85.0
10	1952-1961	2,936	87.8
33	1937-1969	3,345	100.0

Table 217 - Dependable Yield at Sta 72910.00, Homochitto River at Eddiceton, Miss.

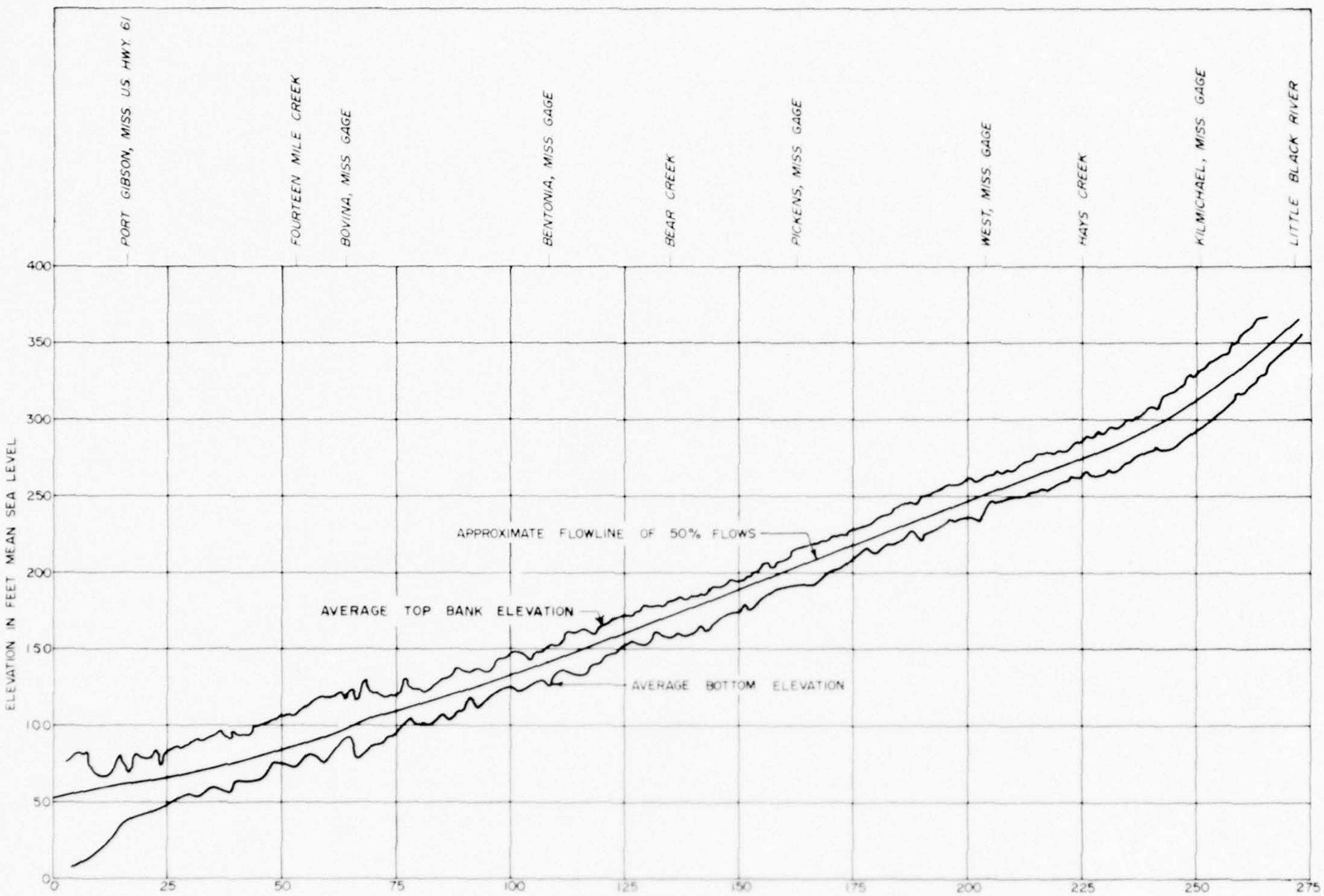
Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1939-1969 Mean
1	1954-1954	92	37.3
2	1956-1957	149	60.4
3	1954-1956	165	66.8
4	1954-1957	159	64.4
5	1954-1958	191	77.6
6	1954-1959	186	75.7
7	1951-1957	188	76.4
8	1952-1959	203	82.6
9	1951-1959	200	81.2
10	1951-1960	208	84.2
31	1939-1969	246	100.0

Table 218 - Dependable Yield at Sta 72925.00, Homochitto River at Rosetta, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1952-1969 Mean
1	1954-1954	348	36.2
2	1954-1955	670	69.7
3	1954-1956	707	73.5
4	1954-1957	707	73.6
5	1954-1958	843	87.7
6	1954-1959	832	86.5
7	1954-1960	842	87.5
8	1952-1959	900	93.6
9	1952-1960	900	93.6
10	1954-1963	952	99.0
18	1952-1969	962	100.0

Table 219 - Dependable Yield at Sta 72950.00, Buffalo River near Woodville, Miss.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1943-1969 Mean
1	1954-1954	79	31.6
2	1963-1964	164	65.6
3	1952-1954	188	75.3
4	1954-1957	186	74.4
5	1959-1963	203	81.4
6	1963-1968	202	80.9
7	1951-1957	206	82.6
8	1950-1957	215	86.3
9	1952-1960	215	86.0
10	1959-1968	213	85.5
27	1943-1969	250	100.0



DISTANCE IN MILES-(1940) ABOVE MOUTH OF BIG BLACK RIVER

FIGURE 343 STREAM PROFILE, BIG BLACK RIVER, MISSISSIPPI

Table 220 - Chemical Analyses of Water from Streams in WRPA 7 in the Lower Mississippi Region, Milligrams Per Liter

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Color
															Calcium, magnesium	Non-carbonate			
							07289270 Hays Creek near Vaiden, Miss.												
Winona Sand	11-13-59	5.5	10	0.32	8.6	5.3	20	5.0	45	30	16	0.2	2.6	132	44	6	197	6.8	25
							07289360 Indian Creek at West, Miss.												
Sparta Sand	11-20-59	1.1	11	0.65	2.9	2.5	8.0	2.3	24	8.0	7.5	0.2	0.7	87	18	0	81	6.7	80
	6- 1-60	.78	3.8	.13	4.1	3.4	12	1.1	30	16	8.0	.1	.4	78	24	0	111	6.6	5
							07289440 Big Black River at Durant, Miss.												
Wilcox Group, Tallahatta Formation, Winona Sd, Sparta Sd.	[a]10- 4-62	--	--	--	--	--	--	--	--	--	4.0	--	--	--	20	--	60	6.8	--
							07289466 Seneasha Creek near Pickens, Miss.												
Sparta Sand, Cook Mt. and Cockfield Fm.	[a]9-21-62	--	--	--	--	--	--	--	--	--	2.4	--	--	--	15	--	50	6.6	--
							07289500 Big Black River at Pickens, Miss.												
Wilcox Group, Tallahatta Formation, Winona Sand, Sparta Sand	2-13-58	3,000	7.4	0.35	4.6	1.4	5.1	1.9	20	7.8	4.5	0.5	0.8	44	18	1	65	6.7	20
	6-10-58	340	8.6	.04	6.9	1.6	5.6	2.7	21	8.2	6.0	.5	1.9	52	24	6	78	6.4	22
	10-22-58	179	4.6	.49	4.9	3.0	6.5	1.4	34	4.6	6.2	.0	1.0	50	24	0	87	6.8	5
	9-10-62	123	9.8	.16	3.4	1.6	5.8	1.8	22	5.2	4.2	.0	.2	43	15	0	66	6.4	40
	10-20-62	106	--	--	--	--	--	--	--	--	--	--	--	--	--	--	70	--	--
	1-10-63	224	--	--	--	--	--	--	--	--	--	--	--	--	--	--	62	--	--
	1-21-63	740	7.6	.47	3.0	1.3	5.3	1.5	15	5.8	4.4	.1	.8	37	13	1	57	6.4	120
	2-27-63	768	--	--	--	--	--	--	--	--	--	--	--	--	--	--	62	--	--
	4- 2-63	376	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80	--	--
	5- 9-63	260	8.9	.04	4.9	1.9	6.0	1.6	22	8.4	5.7	.1	.2	43	20	2	75	6.3	20
	5-29-63	933	--	--	--	--	--	--	--	--	--	--	--	--	--	--	66	--	--
	9-18-63	167	8.8	.18	3.0	1.6	6.7	2.1	17	6.6	7.5	.1	.2	45	14	0	68	6.0	60
	10-14-63	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80	--	--
	2- 6-64	920	13	.25	4.3	1.0	6.2	1.9	14	10	6.3	.2	.4	51	15	4	68	6.1	[illegible]
	3- 9-64	9,540	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	--	--
	4-23-64	2,660	10	.06	3.3	2.6	4.8	1.8	23	5.4	4.1	.1	.5	44	19	0	65	6.8	30
	6- 3-64	507	--	--	--	--	--	--	--	--	--	--	--	--	--	--	125	--	--
	9- 9-64	110	--	--	--	--	--	--	--	--	--	--	--	--	--	--	90	--	--
	9-28-64	84	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100	--	--
	12- 4-64	1,150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	55	--	--

Table 220 - Chemical Analyses of Water from Streams in WRPA 7 in the Lower Mississippi Region, Milligrams Per Liter--Continued

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
07289530 Doaks Creek near Canton at Highway 51, Miss.																			
Cockfield Formation	11-13-59	22	9.7	1.4	5.1	2.7	6.8	1.7	25	9.6	8.0	0.1	0.6	58	24	3	87	6.8	35
	6- 1-60	22	3.5	--	6.5	2.9	8.0	1.7	29	12	8.0	.0	.5	57	28	4	102	6.9	15
07290000 Big Black River near Bovina at Old Highway 80, Miss.																			
Wilcox Group, Tallahatta Formation, Winona Sand, Sparta Sand, Cockfield Fm., Vicksburg Group, Citronelle Fm.	10-20-58	392	4.6	0.55	8.6	4.9	12	3.6	52	6.8	14	0.1	0.9	82	42	0	144	7.0	5
	2-17-59	9,980	1.5	.07	4.4	1.8	5.2	3.9	20	7.6	6	.2	.2	41	18	2	67	6.4	5
	6-25-59	586	2.8	.42	11	4.7	11	2.6	56	7.6	12	.1	1.7	82	47	1	151	6.9	80
	a10- 2-61	--	10.8	--	19	3.0	40		47	5.9	67	--	--	174	61	--	--	7.0	--
	a10-30-61	--	6.8	--	23	3.1	40		61	7.1	62	--	--	178	70	--	--	7.3	--
	b11-27-61	--	23.2	--	4.8	.9	7		13	4.9	9	--	--	60	16	--	--	6.4	--
07290210 Big Black River near Port Gibson at Highway 61, Miss.																			
Wilcox Group, Tallahatta Formation, Winona Sand, Sparta Sand, Cockfield Fm., Vicksburg Group, Catahoula Sandstone, Citronelle Fm.	4- 3-61	--	5.2	0.11	27	6.5	11	2.3	83	30	16	0.2	0.4	140	94	26	250	6.8	80
	7-12-61	--	8.2	.32	10	3.2	29	2.9	32	6.0	51	.2	.5	127	38	12	226	6.4	140
	8-15-61	--	6.7	.51	8.1	2.9	27	3.4	29	5.8	47	.2	.7	173	32	8	230	6.4	120
	9- 8-61	--	7.3	.32	9.1	3.0	16	3.9	34	5.6	28	.2	.5	91	35	7	161	6.8	210
	10-19-61	--	5.9	--	21	8.2	55	3.9	82	7.3	96	.2	1.4	256	86	19	445	7.2	10
	10-27-61	--	8.7	--	22	6.6	40	2.4	95	6.8	62	.2	.2	200	82	4	354	6.8	20
	11-29-61	--	7.0	.34	17	6.5	18	2.4	78	7.2	28	.1	.2	142	69	5	234	6.7	50

a Field analysis
b Analysis by Mississippi State Board of Health

GROUND WATER

Geologic units in the northern part of WRPA 7 (in and north of Hinds County, Miss.) dip to the southwest and are exposed in northwest-striking outcrop belts. The oldest rocks, which are exposed in eastern Choctaw and Webster Counties, belong to the Porters Creek Clay of the Midway Group. Successively younger strata of the Wilcox and Claiborne Groups crop out in central and western Choctaw and Webster Counties. The Claiborne Group underlies Montgomery, Attala, and northern Madison Counties. The Jackson Group crops out in central and southern Madison County.

The oldest rocks exposed in the southern part of WRPA 7 are of Miocene age. The Catahoula Sandstone crops out in Claiborne and Jefferson Counties. The remainder of the area is underlain by the undifferentiated upper Miocene rocks. The Citronelle Formation blankets much of the Miocene outcrop area. The Mississippi River alluvium underlies the irregular floodplain along the western edge of the southern part of WRPA 7.

Ground water in the northern part of WRPA 7 is obtained from the Gordo Formation, lower Wilcox aquifer, Meridian-upper Wilcox aquifer, Sparta Sand, and Cockfield Formation (figure 344). Thin irregular sand beds in the middle part of the Wilcox Group and in the Tallahatta Formation are sources of water for low yielding wells.

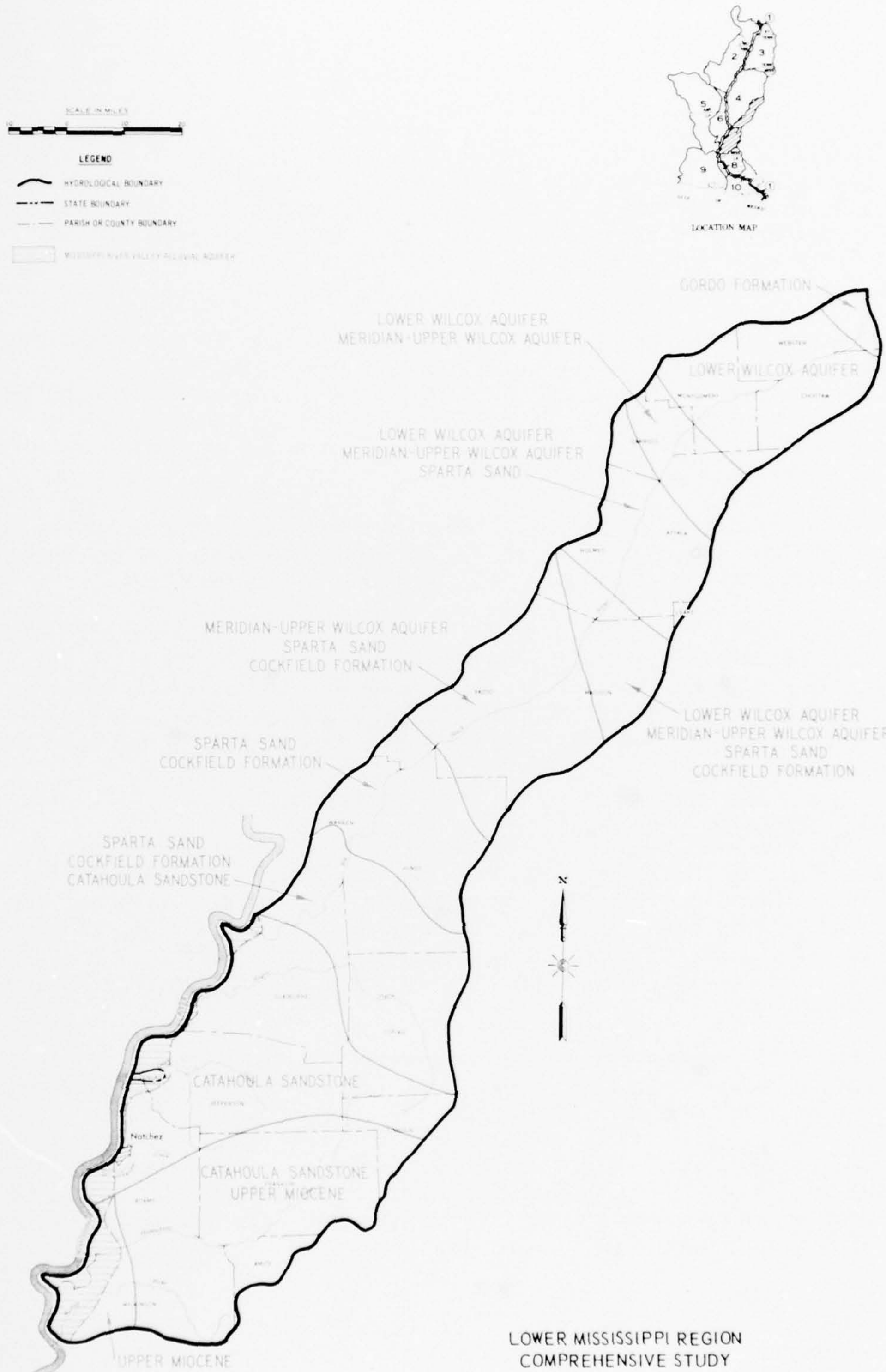
The principal aquifers in the southern part of WRPA 7 are in the Catahoula Sandstone, in younger undifferentiated Miocene deposits, the Citronelle Formation, and the Mississippi River Valley alluvial aquifer.

Cretaceous Aquifers

Tuscaloosa Group and Eutaw Formation

The Gordo Formation of the Tuscaloosa Group and the Eutaw Formation are used as sources of ground water in eastern Webster County. Utilization of the Eutaw Formation is limited due to the high mineralization of the water and the low yielding character of the sand. Several municipal water supplies tap the Gordo Formation, generally at depths of more than 2,000 feet. The dissolved-solids content of water from the Gordo is moderate to high, and it becomes saline in central Webster County. The Gordo is the only source of significant quantities of fresh ground water in approximately the eastern one-third of Webster County.

Wells in the Gordo generally yield 200 to 300 gpm in WRPA 7. The estimated potential yield of the aquifer in the area is about 2 mgd.



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

GEOLOGIC SOURCES OF GROUND WATER

WRPA 7

FIGURE 344

Tertiary Aquifers

Lower Wilcox Aquifer

Aquifers in the Wilcox Group, principally the lower Wilcox aquifer, are the only sources of fresh ground water in central and western Choctaw and Webster Counties. The lower Wilcox aquifer contains fresh water as far downdip as northern Madison County. All Wilcox aquifers in WRPA 7 are thin and irregular, and wells in the aquifers commonly yield less than 300 gpm.

Hydraulic characteristics of the Wilcox aquifer in the area reflect the extreme variation in aquifer thickness and composition. Values of the coefficient of transmissibility range from 1,500 to 55,000 gpd per foot and for permeability, 220 to 1,000 gpd per square foot; however, in some localities there are no sands in the Wilcox Group thick enough to yield significant quantities of water.

Water from shallow wells in the Wilcox aquifers commonly contains excessive iron in solution or is slightly acidic. As the water moves down the dip, the pH increases and the iron content decreases.

Large wells in Wilcox aquifers in WRPA 7 range in depth from about 100 feet at Ackerman to more than 1,000 feet in Attala County. The maximum depth to the aquifer near the downdip limit of fresh water in Madison County is over 3,000 feet. Water level declines in the lower Wilcox aquifer have been small because the requirements for ground water have been low.

Meridian-Upper Wilcox Aquifer

The sand beds forming the Meridian-upper Wilcox aquifer crop out in western Choctaw and Webster Counties and adjoining areas in Montgomery and Attala Counties. The aquifer contains fresh water throughout the northern part of WRPA 7, and it is the principal source of water for public and industrial supplies in Montgomery and Attala Counties. The largest withdrawals from the Meridian-upper Wilcox are made at Winona and Kosciusko.

The Meridian-upper Wilcox is a good aquifer in WRPA 7. The coefficient of transmissibility ranges from 9,000 to 55,000 gpd per foot, and the average permeability is about 450 gpd per square foot.

Water produced from shallow wells commonly requires treatment to raise the pH. The dissolved-solids content of the water is less than 500 mg/l in areas where the aquifer is now used. The water is soft and a sodium bicarbonate type.

Tallahatta Formation and Winona Sand

The Tallahatta Formation and the Winona Sand crop out in Attala and Montgomery Counties. The sands in these formations are not capable

of yielding enough water to supply large wells in WRPA 7 but they are commonly tapped by domestic and other small wells.

The dissolved-solids content of water is generally moderate to high; however, the water in many places is suitable for most uses without treatment.

Sparta Sand

The Sparta Sand crops out in Attala County and dips to the southwest. The formation attains a maximum thickness of about 500 feet in WRPA 4, and the aquifer often comprises two or more thick sand beds. The Sparta is the principal aquifer in Madison County and in western Attala County.

Transmissibility values for thick sand beds in the Sparta are probably similar to values for the Sparta in adjacent areas. Transmissibilities reported for aquifer tests made in Hinds County ranged from 22,000 to 75,000 gpd per foot. Well yields as great as 1,500 gpm have been reported for wells in the Sparta in Madison County.

The Sparta Sand generally yields a soft sodium bicarbonate water of good quality; however, in some localities the water contains excessive iron or is colored.

Canton, the largest producer of water from the Sparta Sand in WRPA 7, withdraws about 2 mgd. The aquifer is capable of supporting much larger yields. Water level declines in WRPA 7 are mostly the result of pumping in the Jackson area (not in WRPA 7) and in WRPA 4, principally in the Yazoo City area.

Cockfield Formation

The Cockfield Formation crops out in northeastern Madison and southwestern Attala Counties. The maximum thickness of the formation in WRPA 7 is about 400 feet in Madison County. Irregular sand beds occur throughout the formation, but the thicker, more permeable sands are usually in the lower part.

The Cockfield is a good aquifer in some areas in WRPA 7. One aquifer test made in Madison County indicated a coefficient of transmissibility of 35,000 gpd per foot. The aquifer is the source of water for most of the small domestic and stock wells in Madison and southwestern Attala Counties and for several community water systems in Madison County.

The water in the Cockfield Formation is a soft sodium bicarbonate type. Although in some places treatment is required for iron removal, the water is generally suitable for most uses without treatment.

Large wells in the Cockfield Formation yield several hundred

gallons per minute. Pumpage from the Cockfield in WRPA 7 totals about 0.5 mgd. Most of the water level decline in the Cockfield in WRPA 7 is the result of regional withdrawals.

Forest Hill Sand and Vicksburg Group

The Forest Hill Sand and Vicksburg Group contain fresh water in northern Claiborne County; however, these aquifers are not potential sources for large supplies of ground water. The materials composing the aquifers in both units are too fine grained to yield more than a few gallons per minute. Also, the water is commonly colored.

Catahoula Sandstone

The Catahoula Sandstone is the only artesian aquifer capable of yielding sufficient water for public and industrial needs in Claiborne, Jefferson, and northern Adams Counties. The deepest fresh water in WRPA 7 south of Claiborne County is in the Catahoula.

The water bearing characteristics of the Catahoula Sandstone improve southward as successively younger beds are included and the sand beds in the formation become thicker.

Aquifer tests indicate coefficients of transmissibility ranging up to about 75,000 gpd per foot for individual sand beds in the Catahoula, and the aggregate transmissibility for all sand beds at localities in and south of Adams County is probably considerably higher. The highest yield reported for wells in the Catahoula in WRPA 7 is about 800 gpm; however, the formation is capable of larger yields.

Water from the Catahoula commonly requires treatment for iron removal or corrosiveness; otherwise, it is generally of good quality.

Present withdrawals of water from the Catahoula Sandstone are about 15 mgd, mostly for public and industrial use in the Natchez area. The potential yield of the Catahoula in WRPA 7 is estimated to be about 35 mgd.

Upper Miocene Aquifers

The Hattiesburg and Pascagoula Formations, of Miocene age, comprise a thick series of alternating sand and clay beds. As there are no satisfactory criteria for differentiating these formations in the subsurface, they are here classified as undifferentiated upper Miocene beds. The undifferentiated Miocene sand beds are the principal sources of ground water in southern Adams, southern Franklin, and Wilkinson Counties.

Coefficients of transmissibility ranging up to 100,000 gpd per foot have been reported for Upper Miocene aquifers in Wilkinson County. The largest reported yield for a well made in Upper Miocene Sand is about 600 gpm; however, much higher yields are feasible.

Water from the Upper Miocene Sands commonly has a low pH and in some places contains excessive iron. The dissolved-solids content is low and the water is a calcium or sodium bicarbonate type.

Pumpage from the Upper Miocene is estimated to be about 2 mgd in the southern part of WRPA 7. The potential yield in the area is about 35 mgd.

Citronelle Formation

Sand and gravel of the Citronelle Formation cap hills and ridges in the southern part of WRPA 7. The Citronelle, a blanket deposit overlying the Miocene erosional surface, is as much as 200 feet in thickness in some places. Most of the recharge from precipitation is rather rapidly discharged to streams; hence, the Citronelle is an important contributor to low flow of streams. The Citronelle is also a source of recharge to the underlying Miocene beds. Although the saturated thickness of the Citronelle is usually less than 100 feet, the aquifer is commonly under water table conditions and yields of several hundred gallons per minute to wells are feasible.

Water from the Citronelle Formation is generally very low in dissolved solids and is acidic. The water commonly contains excessive iron. Pumpage from the Citronelle in WRPA 7 is restricted to domestic and stock water supplies.

Quaternary Aquifers

Mississippi River Valley Alluvial Aquifer

In WRPA 7, the Mississippi Alluvial Plain is irregular in width as a result of the meandering course of the Mississippi River. At some places, the river impinges on the bluffs forming the eastern boundary of the alluvial plain; elsewhere, the alluvial plain extends more than 10 miles east of the river.

The alluvial deposits in the western part of WRPA 7 properly average more than 100 feet in thickness and are abundantly water bearing. Recharge is mostly by precipitation; however, the alluvial aquifer is occasionally recharged by flooding (levees have not been constructed on the east side of the river in WRPA 7).

Wells in the Mississippi River Valley alluvial aquifer are capable of large yields. The coefficient of transmissibility for the aquifer is estimated to be as high as 250,000 gpd per foot. Industrial wells made in the aquifer in the Natchez area commonly yield 2,000 gpm or more, and reported specific capacities range from 30 to 150 gpm per foot of drawdown.

Water from the Mississippi River Valley alluvial aquifer is

generally a very hard calcium bicarbonate type containing several milligrams per liter of iron in solution.

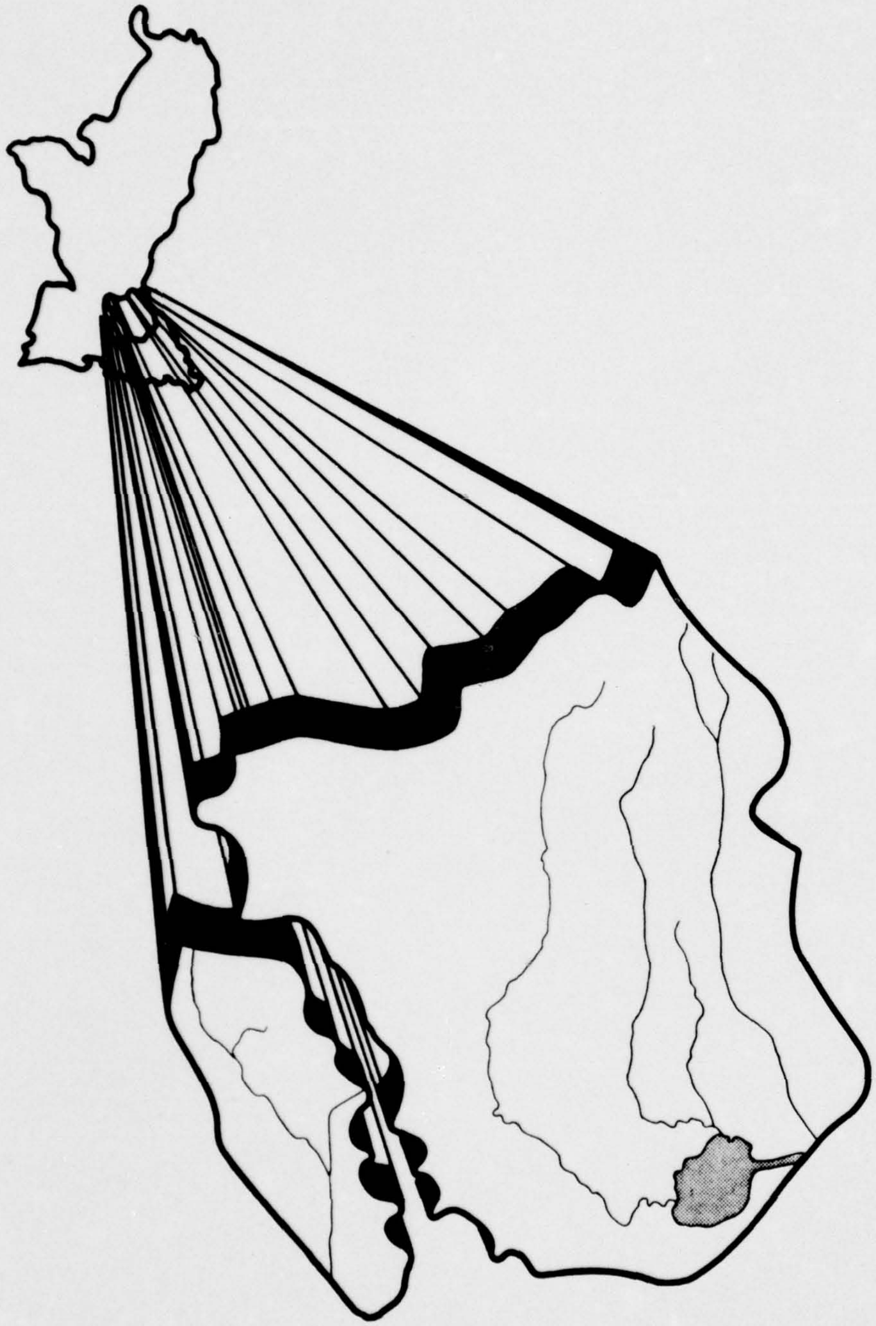
About 37 mgd is pumped from the alluvial aquifer in WRPA 7. The potential yield of the aquifer is estimated to be nearly 120 mgd; however, the potential yield will be greatly increased if well fields are located near the Mississippi River or near other major streams.

Effects of Ground Water Withdrawals and Management Considerations

Water level declines in the Cretaceous and Tertiary aquifers in the northern part of WRPA 7 have been small, reflecting the effects of regional ground water withdrawals rather than withdrawals within the area. The largest withdrawals are made from the Meridian-upper Wilcox aquifer and the Sparta Sand, the aquifers having the best potential for future development. From the standpoint of planning and management, the extreme northern part of the area is characterized by deep (over 2,000 feet), comparatively low yielding aquifers containing moderately mineralized water. A short distance to the southwest, shallow aquifers in the Wilcox Group are available, but these aquifers are also generally low yielding; hence, Choctaw, Montgomery, and Webster Counties, Miss., do not have a great potential for ground water development. The remainder of the northern part of WRPA 7 is underlain by excellent sources of ground water, the Meridian-upper Wilcox aquifer and the Sparta Sand.

The only significant water level declines in the southern part of WRPA 7 have occurred in two zones in the Catahoula Sandstone in the Natchez, Miss., area where about 15 mgd is pumped from the aquifer for municipal and industrial water supplies. Although significant, the decline at Natchez is not serious. Regional declines in Upper Miocene aquifers in the southern part of WRPA 7 are mostly the result of large withdrawals in the Baton Rouge area (about 50 miles south in WRPA 8).

Water levels in the Mississippi River alluvial aquifer are unaffected except in industrial areas south of Natchez where the normal streamward slope of the potentionmetric surface has been reversed as a result of industrial pumpage from the alluvium.



WRPA 8

W R P A 8

INTRODUCTION

WRPA 8, an area covering 5,705 square miles and representing approximately 6 percent of the Lower Mississippi Region, lies in southeastern Louisiana. About 5,521 square miles of the area are land, and the remaining 184 square miles are covered with water. The area is bounded on the west by the East Atchafalaya Basin protection levee and the Mississippi River, on the north by the Homochitto and Bogue Chitto River Basins, on the east by the Tchefuncta River and Lake Pontchartrain, and on the south by the Mississippi River. The Mississippi River (WRPA 1) divides WRPA 8 into two areas, with approximately one-eighth of the area located west of the Mississippi River. Five major streams discharge flow from WRPA 8 into WRPA 10. The Amite, Tickfaw, Natalbany, and Tangipahoa Rivers originate in WRPA 8. Tide influences the area adjacent to Lakes Maurepas and Pontchartrain. Major hurricanes may raise Lake Maurepas and Pontchartrain as much as 10 feet above m.s.l. 1/

The Amite River has its source in southwestern Mississippi and flows in a southern and southeasterly direction for a distance of 170 miles to Lake Maurepas. From its mouth, there is a navigable connection through Lake Maurepas and Pass Manchac to Lake Pontchartrain and thence to New Orleans, La., and the Gulf Intracoastal Waterway and other Mississippi River ports. The head of navigation on the Amite is at the mouth of Bayou Manchac (mile 35.75). In the reach below mile 35.75, the channel of the Amite meanders through a heavily timbered swamp with little relief. Between Bayou Manchac and the mouth of the Comite River (mile 54), the Amite meanders through a narrow timbered valley cut through low pine-covered hills. From this juncture, the Amite has a steep bed slope to its source, and is a typical hill country stream. The principal tributaries of the Amite River are Bayou Manchac, the Comite River, and Colyell Creek. Bayou Manchac and its tributaries drain the lower portion of the city of Baton Rouge, La., and a large area of lowlands lying south and east of Baton Rouge. The Comite River enters the Amite River below Denham Springs, La., and its tributary, Hurricane Creek, drains the upper portion of the city of Baton Rouge and the surrounding area. Colyell Creek, with its many branches, enters the Amite River below Port Vincent, La., and drains an extensive area of gently rolling uplands in Livingston Parish.

The Tickfaw River has its source in southwestern Mississippi and flows in a southerly direction through St. Helena, Livingston, and

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1/ Mean sea level - the datum to which all elevations are referenced unless otherwise noted.

Tangipahoa Parishes to Lake Maurepas. The Natalbany River, from its head to mile 25, flows through low pine hills; the lower 25 miles of channel winds through heavily timbered swamps to Lake Maurepas. The principal tributaries of the Tickfaw River are the Blood, Natalbany, and Pontchartrain Rivers.

The Tangipahoa River originates in southwest Mississippi near the town of McComb, Miss., and flows in a southerly direction for a distance of about 110 miles to its terminus in the northwest portion of Lake Pontchartrain. The stream varies in width from a few feet in the upper reaches to about 200 feet near the mouth. Streamflow is fairly rapid in the upper reaches but becomes tidal in the lowlands adjacent to the lake.

SURFACE WATER

Quantity

The average annual discharge of all streams originating in WRPA 8 is about 5,700 c.f.s., or about 1.0 c.f.s. per square mile.

Present Utilization

Withdrawals from surface water sources in WRPA 8 during 1970 averaged about 3,045 c.f.s., or about 89 percent of the total water withdrawn. Withdrawals from brackish water sources for this area averaged only 19 c.f.s. and the water was withdrawn for use by mineral industries in the area. The major fresh water withdrawals were for industrial uses (about 2,100 c.f.s.) and thermoelectric power (900 c.f.s.).

Ground water withdrawals in WRPA 8 during 1970 averaged about 370 c.f.s. Of this amount, 17 c.f.s. was from brackish sources. Major ground water withdrawals were for industrial purposes (about 250 c.f.s.).

During 1970, about 720 c.f.s., or 21 percent of the total surface and ground water withdrawals from WRPA 8, were consumed. The remaining 2,700 c.f.s. was released and returned to nearby streams, thus resulting in a net decrease to streamflow of about 335 c.f.s. The major consumption of water in the area was for industrial purposes (600 c.f.s), which comprised 84 percent of the total amount of water consumed. The second leading consumer of water was for hydroelectric power production (59 c.f.s.). Major nonconsumptive uses of water were for fishing, boating, and related water sports.

Additional information on the withdrawals of ground and surface water in WRPA 8 during 1970 is given in table 15 of the Regional Summary. This table also presents pertinent data on the consumption of water for various purposes in this WRPA and in each of the other areas in the Lower Mississippi Region.

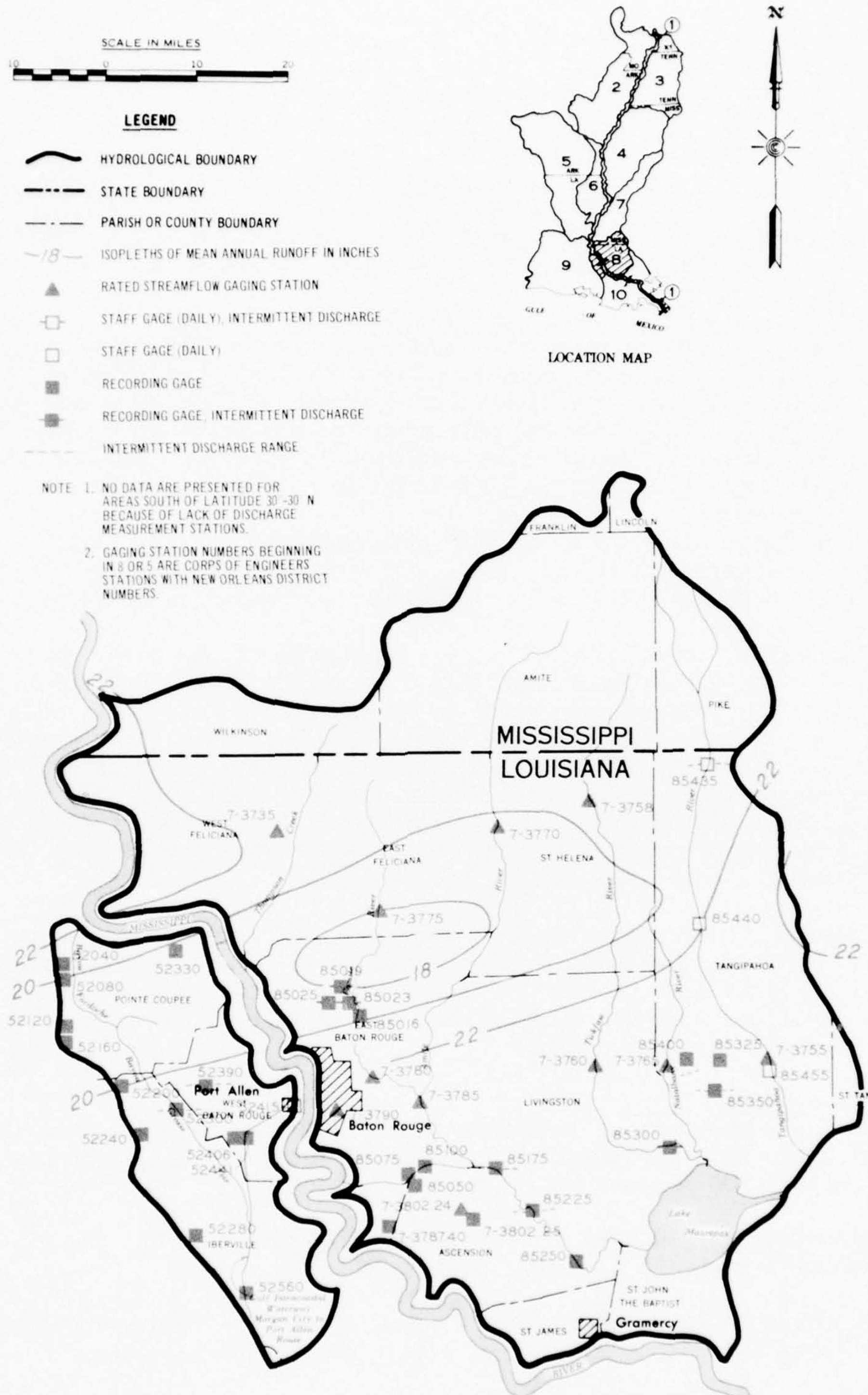
Stream Management

The major purposes for management of streamflow in WRPA 8 are industrial usage and flood control. In the tributary basins, emphasis is almost entirely on industrial usage.

Impoundments. In WRPA 8 there are no reservoirs which have a total capacity of 5,000 acre-feet or more.

Diversions. Most of the diversions are made for fish and wildlife; the remaining diversions are for municipal and industrial uses.

Channel modification. Channel modification, which consisted of



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

MEAN ANNUAL RUNOFF IN INCHES

WRPA 8

FIGURE 345

channel enlargement, clearing, and snagging, has taken place on the major streams in WRPA 8.

Navigation. Inland water navigation is provided on the Amite, Tickfaw, Natalbany, and Tangipahoa Rivers and the Gulf Intracoastal Waterway from Morgan City to Port Allen, La.

Streamflow

In this study, the various periods of flow that were used for the selected gaging stations were determined by the availability of discharge data at the sites.

Measurement facilities. Streamflow data at four sites in WRPA 8 were selected for presentation in this section. Because of tidal influences, daily discharge records are available only for the headwater areas of the principal streams; however, daily stage records are available from stations located within the areas of tidal influence. The locations of these sites are shown in figure 345, and are identified by U. S. Geological Survey and Corps of Engineers station numbers. A summary of the controlling agency, drainage area (where available), period of record, gage datum, and other pertinent data for each of these stations is shown in table 221.

Average discharge for WRPA 8. Figure 345 also presents isopleths showing the mean annual runoff for the northern part of WRPA 8. (Mean annual runoff data for the southern part were not available because of tidal influence.) Streams originating in WRPA 8 have an estimated average annual discharge of about 5,700 c.f.s.

Average discharge for selected stations. Observed mean discharges by months for selected gaging stations in WRPA 8 are given in tables 222-225.

Figures 346-349 are graphical representations of the average monthly discharge for selected discharge sites. The figures also present the maximum, minimum, 20 percent, and 80 percent duration monthly flows for WRPA 8.

Peak flow frequency curves for each study station are shown in figures 350-353. These curves reflect the annual peak discharge for each station.

Low flow frequency curves for each study station are shown in figures 354-357. These curves represent the lowest average flow for periods of 7, 15, 30, and 60 consecutive days. Low flow frequency curves are used in determining the dependable supply of surface water without storage in a stream.

Duration curves for daily flows are presented in figures 358-361.

Table 221 - Streamflow Data for Water Resources Planning Area 8, East Atchafalaya, Amite, Tickfaw, Natalbany, and Tangipahoa River Basins

Stream	Station	Station No.	Gage Datum (feet)	Drainage Area (sq. mi.)	Period of Record	Mean (c.f.s.)	Gage Readings (feet)		Momentary Flow (c.f.s.)		Agency
							Maximum	Minimum	Maximum	Minimum	
EABPL Borrow Pit	Bayou Fordoche	52040	0.00		43-55 1/ 58-70		28.1	18.0 2/			CE
EABPL Borrow Pit	Bayou Fordoche	52080	0.00		47-55 1/ 58-70		28.0	16.0 2/			CE
EABPL Borrow Pit	Lottie	52120	0.00		37-56 1/ 56-70		25.8	7.9			CE
EABPL Borrow Pit	Lottie	52160	0.00		38-50 1/ 51-70		23.5	7.4 2/			CE
EABPL Borrow Pit	Near Maringouin	52200	0.00		48-70		17.4	0.5			CE
EABPL Borrow Pit (LS) 3/	Ramah	52240	0.00		35-46 1/ 48-70		12.7	0.4			CE
Upper Grand River (LS) 3/	Dike	52280	0.00		33-45 1/ 48-70		13.0	-0.1			CE
Bayou Grosse Tete	Friscoville	52320	0.00		56-70		18.1	2.0 2/			CE
False River	New Roads	52330	0.00		63-70		20.6	14.6			CE
Bayou Grosse Tete	Near Tarbert	52342	0.00		65-70		17.9	3.9			CE
Bayou Grosse Tete	Livonia	52356	0.00		65-70		17.6	2.0			CE
Bayou Grosse Tete	Rosedale	52360	0.00		65-70		14.3	1.0			CE
Choctaw Bayou	Near Rosedale	52390	0.00		65-70		13.7	0.8			CE
Choctaw Bayou	Morley	52406	0.00		41-42 1/ 53-67		12.0	0.1			CE
Intracoastal Waterway	Port Allen Lock	52415	-0.52		61-70		8.9	1.4			CE
Intracoastal Waterway	Morley	52441	0.00		66-70		8.3	1.6			CE
Bayou Plaquemine	Plaquemine Lock	52480	-10.10		23-64		25.0	9.8			CE
Lower Grand River	Bayou Sorrel Lock	52560	0.00		51-70		7.0	-0.3			CE
Little Tangipahoa River	Magnolia (Miss.)	85430	0.00		56-69		294.8	287.4 4/			CE
Tangipahoa River	Near Magnolia (Miss.)	85426	0.00		56-69		285.6	276.6 4/			CE
White Bayou	Near Zachary	85019	0.00		65-70		86.7	69.0			CE
Stewart Swamp Division Canal	Near Fred	85022	0.00		65-70		78.1	66.6			CE
Baker Canal (South)	Near Baker	85025	0.00		65-70		79.5	63.8			CE
Comite River	Near Baker	85016	0.00		65-70		73.3	52.9			CE
Amite River	Near Denham Springs	85040	3.87	1,280	38-70	1,824	32.5 35.4 5/	4.6	67,000	271	CE-USGS
Alligator Bayou	Spanish Lake Floodgate (Upper)	85050	0.00		55-70		10.0	-0.4			CE
Alligator Bayou	Spanish Lake Floodgate (Lower)	85075	0.00		55-70		13.5	-2.4			CE
Bayou Manchac	Hope Villa	85100	0.00		45-70		14.8	-1.6			CE
Amite River	Port Vincent	85175	0.00		54-70		11.5	-1.6			CE
Amite River	French Settlement	85225	0.00		54-70		6.8	-1.5			CE
Petite Amite River	St. Paul	85250	0.00		51-70		4.5	-1.6			CE
Tickfaw River	Springfield	85300	0.00		47-70		4.8	-1.4			CE
Ponchatoula Creek	Hammond	85325	0.00		48-70		38.4	20.6			CE
Ponchatoula Creek	Near Ponchatoula	85350	0.00		48-70		17.4	-0.7			CE
Yellow Water River Canal	Near Hammond	85400	0.00		48-70		37.0	20.0 2/			CE
Pass Manchac	Near Ponchatoula	85420	0.00		55-70		4.7	-2.0			CE
Tangipahoa River	Near Kentwood	85435	0.00		62-70		216.2	205.0			CE
Tangipahoa River	Near Amite	85440	0.00		62-70		100.6	86.0			CE
Tangipahoa River	Near Robert	85455	0.00		55-70		24.0	5.1			CE
West Fork Thompson Creek	Near Wakefield	7-3735	120.0 6/	35	49-70	43	22.6	2.8	18,100	2	USGS
Tangipahoa River	Robert	7-3755	6.87	646	38-70	1,057	23.1	3.0	50,500	3	USGS
Tickfaw River	Holden	7-3760	19.15	247	40-70	344	19.8	1.3	14,500	65	USGS
Natalbany River	Baptist	7-3765	11.28	80	43-70	107	19.7	3.0	9,550	2	USGS
Amite River	Near Darlington	7-3770	145.81	580	49-70	791	18.2	1.3	55,700	188	USGS
Comite River	Near Olive Branch	7-3775	115.65	145	42-70	220	21.4	1.6	19,900	31	USGS
Comite River	Near Comite	7-3780	25.85	284	44-70	436	28.6	1.0	20,900	29	USGS
Bayou Braud	Near St. Gabriel	7-3787.4	18.0 6/		65-70		10.2	1.7			USGS
Black Bayou	Near Duplessis	7-3802.24	10.0 6/	4	64-70	4	8.2		452	0	USGS
Black Bayou	Near Gonzales	7-3802.25	5.0 6/	9	64-70		8.8	-0.2			USGS
Tickfaw River	Liverpool	7-3758	206.0 6/	90	56-68	112	11.7	1.8	9,220	29	USGS
Ward Creek	Government Street	7-3790	32.82	4	54-66	10	13.6	0.4	2,030	1	USGS

1/ Intermittent gage record.
2/ Lower limit of gage - water below gage.
3/ LS - Landside.
4/ Maximum and minimum gage readings from intermittent discharge records.
5/ Highwater mark.
6/ Altitude of gage from topographic map.

The curves indicate the percent of time that any given flow is equaled or exceeded at each site. The occurrence of these flows is not necessarily during consecutive periods, but may have occurred at any time during the period of record for the station.

Tables 226-229 present data on the dependable yield characteristics at each of the selected discharge sites. These tables show the lowest mean flows for from 1 to 10 consecutive years of the period of record.

Flow Velocities

Time of travel studies have been made on the Comite, Amite, Tickfaw, and Tangipahoa Rivers in WRPA 8. Travel times were measured with dye tracings through subreaches of each stream during conditions of low flow. These data were used to compute the average velocity of flow in each subreach, as shown in figure 52.

The velocities correspond to specific discharges, and since velocity is a function of discharge, the user should be cautious in applying these data to any other condition of flow. In general, stream velocities vary with discharge so that at higher discharges, greater velocities would be expected. The discharges shown in figure 52 for WRPA 8 are for flows which are equaled or exceeded about 98 percent of the time.

The velocities represent the average velocity through a subreach; however, velocities can vary from point to point within a subreach. The velocities given in WRPA 8 were based on preliminary information and are subject to revision upon completion of further studies.

River Profiles

Profiles of the major streams in WRPA 8 are shown in figures 362-365. The profiles were constructed from topographic maps and hydrographic surveys. The average annual high water state was plotted from data at various gaging stations along the river.

HURRICANE OVERFLOW

Figure 366 outlines the areas which would be flooded by the occurrence of a hurricane with a once in 100-year return frequency and a Standard Project Hurricane (SPH). The SPH is defined as a synthetic hurricane which represents the most severe combination of hurricane parameters that is reasonably characteristic for a specified region, excluding extremely rare combinations. The frequency of recurrence for the SPH is dependent on the vulnerability of the location of interest to hurricanes on tracks critical to the area. It is considered to be such a rare event that the assignment of the frequency is inappropriate. Parameters for the SPH, from which hurricanes of other intensities may be derived, have been assigned by the U. S. National Weather Service and mutually agreed upon by representatives of that agency and the Corps of Engineers. The limits of flooding, as shown in figure 366, represent flooding which would be caused by many hurricanes whose tracks would be critical to all areas simultaneously. This was accomplished by transposing the tracks successively along the coast so that each segment of coast in turn would be subjected to maximum flooding from the same intensity hurricane.

Quality

The water in WRPA 8 is suitable for most uses with little or no treatment. Streams in the area are made up of varying proportions of water from direct runoff and ground water discharge. At low flow, most of the stream discharge consists of ground water discharge into the stream, and at high flow most of the discharge consists of direct runoff. Usually the dissolved-solids contents of the water are greatest at low flow and lowest during periods of high flow; however, analyses of samples collected from the Tangipahoa River at Robert, La., and the Amite River near Denham Springs, La., during the period October 1970 to August 1971 indicate that the dissolved-solids content did not vary over a wide range with variation in water discharge. In fact, analyses of water from these streams show that the dissolved-solids content ranged from 37 to 65 mg/l for both rivers. The water is soft, the greatest hardness measured being 17 mg/l. All the chemical constituents analyzed were below the maximum concentration allowed for most uses. The source and concentration of selected constituents are shown in table 230.

Table 222 - Observed Mean Discharge in c.f.s., Sta 7-3785, Amite River near Denham Springs, La., 1938-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1938												412	
1939	318	356	500	1,103	2,237	2,679	1,390	2,333	2,587	689	576	483	1,264
1940	349	323	441	552	2,582	1,170	3,574	2,146	2,064	5,309	2,909	860	1,854
1941	394	1,111	6,040	1,993	972	2,123	1,240	780	1,237	1,026	1,154	525	1,560
1942	411	484	1,220	2,066	2,547	3,027	2,771	1,171	1,312	1,100	1,700	2,359	1,673
1943	725	616	2,536	2,010	4,133	8,890	1,887	731	683	692	520	1,750	2,090
1944	444	1,646	3,027	3,617	2,465	3,700	2,755	1,713	786	522	1,123	922	1,894
1945	760	1,382	1,903	3,796	4,736	1,339	2,857	1,808	939	866	775	525	1,787
1946	1,136	563	1,971	4,874	3,611	3,674	743	4,294	2,718	3,926	1,301	1,284	2,511
1947	593	2,142	1,932	6,982	1,305	6,731	5,366	1,091	1,475	639	591	838	2,483
1948	524	2,084	3,924	2,859	4,539	8,997	1,635	1,011	579	582	523	701	2,330
1949	467	4,328	6,002	3,078	5,994	6,302	5,538	3,670	1,221	2,792	1,436	987	3,469
1950	1,426	836	711	6,062	4,277	4,405	1,874	1,430	3,047	958	840	631	2,198
1951	874	507	1,666	2,103	4,657	4,614	4,086	837	1,102	954	596	529	1,858
1952	425	467	1,210	620	1,918	1,022	2,018	1,595	556	518	496	359	929
1953	307	383	834	1,877	5,153	4,680	2,299	13,590	1,050	1,457	1,230	515	2,781
1954	367	495	4,297	2,358	1,077	948	1,175	1,619	454	481	386	581	1,202
1955	563	405	778	2,573	5,760	850	6,708	937	540	1,127	2,183	537	1,880
1956	363	512	2,011	650	6,391	4,975	1,107	535	752	670	442	366	1,548
1957	310	334	621	515	1,326	2,260	2,725	1,208	1,146	1,642	550	1,152	1,146
1958	1,303	4,733	2,088	2,913	2,679	3,683	2,230	1,610	1,645	1,052	830	1,955	2,218
1959	638	518	526	941	6,591	1,721	1,869	2,248	3,048	1,391	1,818	649	1,794
1960	733	1,069	3,238	2,618	2,943	1,362	1,065	1,153	500	466	1,120	621	1,405
1961	429	578	578	4,100	6,651	6,960	3,647	870	871	1,011	878	1,853	2,341
1962	539	2,486	7,197	4,985	1,255	869	5,629	1,730	1,489	653	624	573	2,342
1963	556	417	519	1,387	1,403	914	512	419	452	595	531	368	669
1964	296	350	623	2,122	1,744	7,475	3,030	1,425	579	2,729	833	459	1,813
1965	5,821	1,263	3,062	1,061	3,444	3,406	770	512	454	564	638	1,348	1,859
1966	425	544	1,378	4,548	11,810	3,649	3,486	1,902	765	638	507	450	2,445
1967	434	452	420	686	1,689	823	6,823	3,993	833	623	672	470	1,485
1968	395	355	1,474	1,551	609	1,321	1,887	1,737	662	545	602	398	965
1969	354	463	2,534	906	2,756	3,207	4,410	2,050	467	1,023	496	343	1,584
1970	1,839	370	890	856	704	2,189	1,450	696	762	667	543	627	970
Mean	766	1,018	2,067	2,449	3,436	3,436	2,767	1,964	1,149	1,184	919	804	1,824

Table 223 - Observed Mean Discharge in c.f.s., Sta 7-3760, Tickfaw River at Holden, La., 1941-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1941	100	204	1,105	386	161	362	309	141	179	169	249	143	294
1942	103	106	250	408	486	512	241	319	318	264	535	579	343
1943	154	135	532	397	662	1,696	273	165	166	171	166	314	402
1944	111	266	356	607	390	612	423	279	198	123	187	184	311
1945	113	213	309	557	765	250	442	366	147	239	162	111	303
1946	244	133	349	827	534	855	148	641	413	891	353	417	486
1947	149	339	421	1,310	265	1,190	1,199	233	218	131	122	183	482
1948	136	592	991	416	790	1,578	293	192	131	142	131	277	472
1949	119	790	992	454	960	1,037	947	656	265	468	284	209	596
1950	229	134	163	831	866	926	375	209	806	207	191	178	423
1951	155	129	279	448	928	790	684	158	157	170	122	121	341
1952	96	104	148	127	382	209	358	246	135	119	107	101	177
1953	81	88	150	349	754	742	372	1,960	185	371	245	132	453
1954	96	147	1,145	467	219	186	239	296	111	111	89	172	275
1955	117	110	140	508	903	138	860	183	115	262	840	116	354
1956	96	110	291	163	1,126	904	207	135	136	114	103	89	287
1957	87	87	125	98	261	349	436	142	116	116	99	452	196
1958	183	947	371	385	569	770	389	528	193	287	187	165	413
1959	110	99	103	142	997	287	280	279	927	272	309	121	321
1960	248	202	418	464	706	252	281	179	104	102	167	105	268
1961	100	94	101	417	1,627	1,270	619	177	180	287	277	246	442
1962	131	501	1,565	1,144	265	218	1,118	498	338	153	143	143	521
1963	119	111	122	245	304	197	118	97	129	150	120	93	150
1964	83	86	139	509	427	1,407	738	335	130	163	130	97	354
1965	591	273	693	241	767	669	162	113	101	112	106	146	329
1966	102	94	155	681	2,592	798	500	285	124	142	175	108	465
1967	109	101	117	193	326	146	1,210	410	133	151	156	158	266
1968	91	90	126	228	115	226	587	276	125	98	85	75	177
1969	71	78	543	168	387	507	909	302	112	148	113	84	284
1970	85	77	116	146	156	354	282	107	130	115	110	96	148
Mean	140	215	410	444	656	648	500	330	217	208	202	180	344

Table 224 - Observed Mean Discharge in c.f.s., Sta 7-3765, Natalbany River at Baptist, La., 1943-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1943												253	
1944	7	75	105	300	130	199	64	123	24	8	22	35	92
1945	9	137	103	214	257	32	113	80	13	85	46	15	91
1946	121	8	114	301	165	375	12	257	141	230	75	45	155
1947	18	76	73	417	22	529	439	30	26	4	8	77	144
1948	21	317	521	128	180	520	32	17	6	13	5	108	156
1949	6	750	315	95	247	286	243	121	33	190	120	59	204
1950	70	9	31	173	322	352	93	30	412	30	26	41	131
1951	25	9	75	130	240	374	91	17	14	33	15	17	86
1952	7	6	11	13	181	51	144	53	13	14	9	10	42
1953	3	9	74	171	366	206	168	791	156	127	52	11	177
1954	7	178	710	139	77	33	120	52	10	31	6	13	115
1955	43	38	27	164	265	15	230	32	6	78	296	12	99
1956	8	32	24	34	418	231	45	45	77	26	16	9	79
1957	8	5	61	10	83	88	224	17	27	8	23	54	50
1958	17	301	105	137	222	327	143	195	28	116	29	37	137
1959	9	7	7	47	368	57	37	82	341	121	125	38	101
1960	133	37	96	98	241	62	138	59	9	18	65	14	80
1961	7	6	12	119	819	457	158	49	28	166	82	127	165
1962	14	270	622	351	34	41	310	53	92	14	10	19	153
1963	34	5	15	41	11	33	8	6	16	20	11	7	25
1964	3	15	51	178	221	521	313	63	9	20	12	178	131
1965	48	65	184	137	344	161	26	21	7	18	20	21	86
1966	5	3	19	227	1,026	135	123	28	15	14	26	28	131
1967	16	6	13	47	131	19	453	90	22	23	52	42	75
1968	6	5	39	95	19	104	45	32	15	16	46	6	36
1969	6	13	276	43	139	218	398	92	10	23	6	6	102
1970	21	5	13	33	42	156	62	16	28	12	26	17	36
Mean	25	88	137	142	243	208	157	91	58	54	46	46	107

Table 225 - Observed Mean Discharge in c.f.s., Sta 7-3755, Tangipahoa River at Robert, La., 1939-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1939	323	325	444	816	1,168	1,149	812	678	1,426	571	506	331	708
1940	298	294	315	381	1,651	747	1,706	1,175	939	2,381	658	401	909
1941	371	428	2,740	1,312	604	924	894	435	503	663	619	414	830
1942	331	356	703	1,459	1,365	1,379	722	818	592	544	921	1,279	870
1943	478	406	2,215	1,125	1,722	5,106	976	611	451	455	424	1,193	1,266
1944	416	814	889	2,062	1,246	2,178	1,439	1,393	593	420	572	727	1,063
1945	518	1,088	1,169	1,636	2,024	1,012	1,275	983	772	978	716	416	1,043
1946	823	502	1,253	2,342	1,684	2,482	673	1,773	1,325	3,112	953	1,267	1,521
1947	626	1,114	1,197	3,873	876	2,993	3,917	950	856	560	540	626	1,515
1948	540	1,615	2,844	1,257	2,080	4,617	920	600	466	481	555	1,526	1,459
1949	494	3,122	2,744	1,275	2,450	2,665	2,657	2,710	1,048	1,601	1,260	1,012	1,915
1950	721	557	713	1,961	2,640	2,355	1,056	865	1,703	828	696	555	1,212
1951	638	469	843	1,128	2,402	2,336	2,023	624	632	650	476	492	1,050
1952	376	407	654	496	1,295	758	1,042	678	429	420	373	359	604
1953	304	362	565	1,113	2,094	1,559	950	4,689	878	1,108	973	475	1,255
1954	365	665	3,691	1,262	751	717	880	630	451	494	367	507	902
1955	533	485	564	1,449	2,236	551	2,234	653	376	565	1,117	422	922
1956	371	460	769	504	3,100	2,211	653	537	763	752	467	439	910
1957	398	363	657	487	809	931	1,994	539	561	460	422	1,381	746
1958	682	2,381	1,173	1,194	1,481	2,359	1,268	1,315	768	950	646	587	1,231
1959	452	478	480	636	2,507	950	1,000	1,038	2,616	936	948	542	1,035
1960	759	876	1,052	1,184	1,715	976	1,254	885	421	441	934	502	914
1961	385	382	413	1,628	5,902	3,908	1,811	647	1,025	1,314	898	1,170	1,594
1962	566	3,041	4,534	3,396	1,034	818	2,397	1,172	1,416	600	558	486	1,671
1963	550	423	491	807	1,009	698	437	362	356	464	374	356	525
1964	306	350	557	1,321	1,311	3,789	2,219	774	474	654	602	372	1,062
1965	1,594	744	1,868	969	2,237	1,454	528	422	376	380	431	452	949
1966	358	407	503	2,074	7,611	1,919	1,003	812	475	448	488	460	1,337
1967	417	382	412	643	949	530	3,292	923	481	415	377	389	762
1968	270	303	774	844	487	667	885	976	404	363	345	321	555
1969	287	316	1,998	675	1,033	1,458	2,145	1,207	447	603	493	373	920
1970	425	304	463	541	569	1,060	701	435	593	539	607	407	554
Mean	499	757	1,240	1,308	1,876	1,789	1,430	1,010	769	786	635	629	1,057

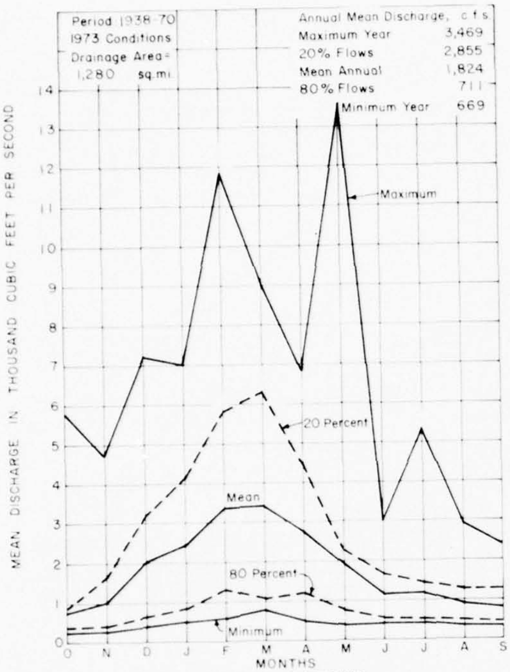


FIGURE 346 MONTHLY DISCHARGE
7-3785 AMITE RIVER NEAR DENHAM SPRINGS, LA

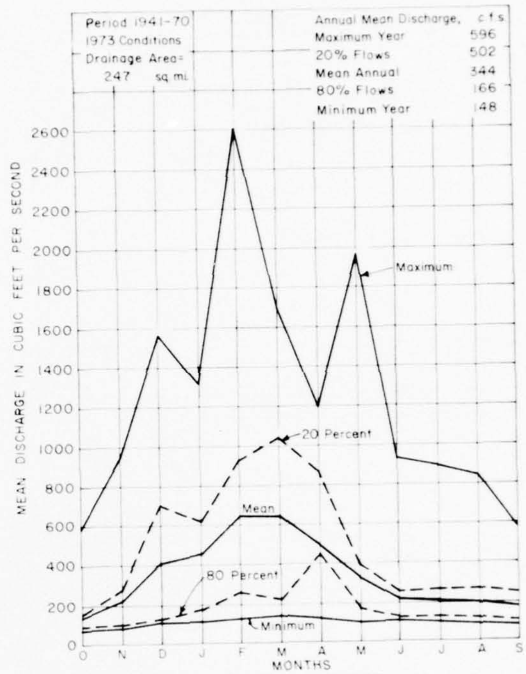


FIGURE 347 MONTHLY DISCHARGE
7-3760 TICKFAW RIVER NEAR HOLDEN, LA.

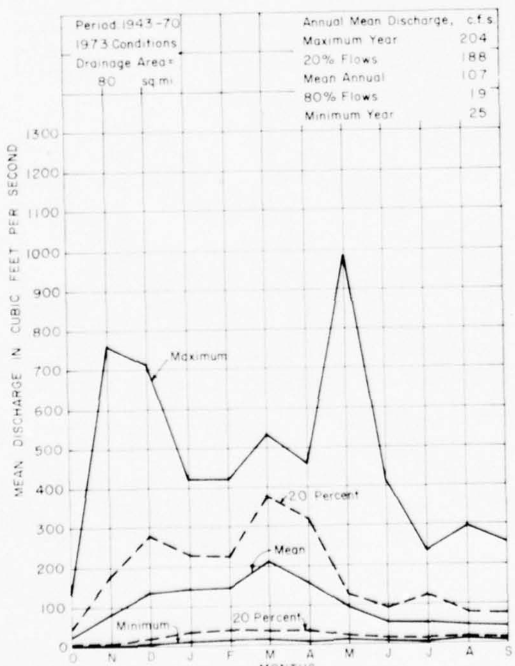


FIGURE 348 MONTHLY DISCHARGE
7-3765 NATALBANY RIVER AT BAPTIST, LA.

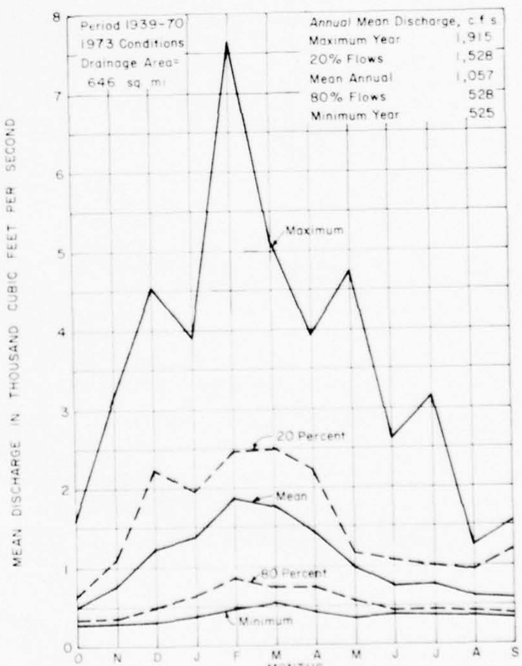


FIGURE 349 MONTHLY DISCHARGE
7-3755 TANGIPAHOA RIVER AT ROBERT, LA.

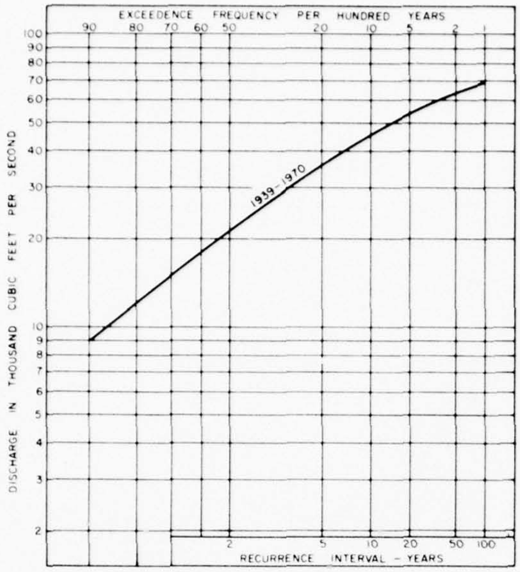


FIGURE 350 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3785 AMITE RIVER NEAR DENHAM SPRINGS, LA.

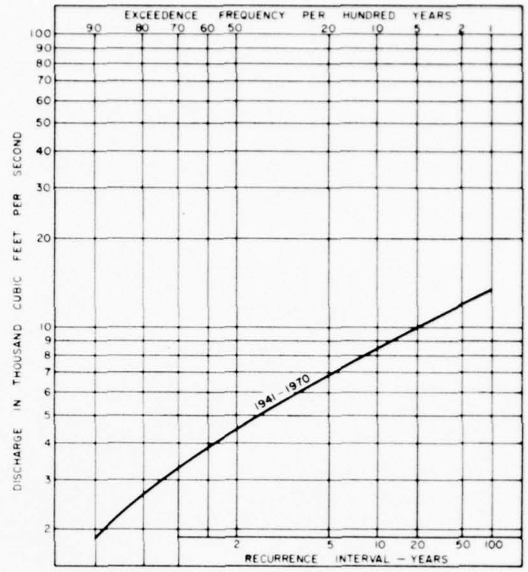


FIGURE 351 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3760 TICKFAW RIVER AT HOLDEN, LA.

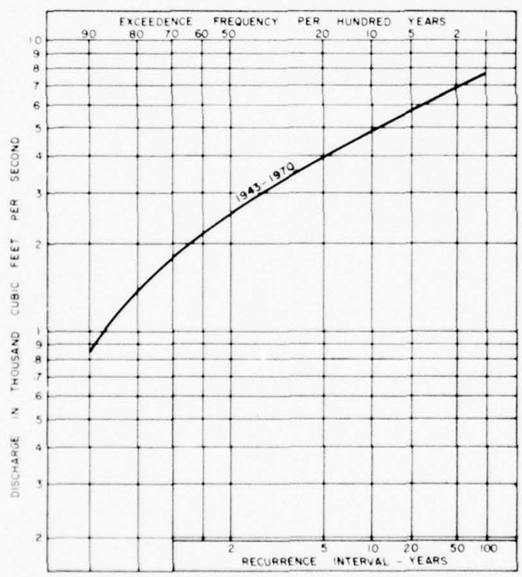


FIGURE 352 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3765 NATALBANY RIVER AT BAPTIST, LA.

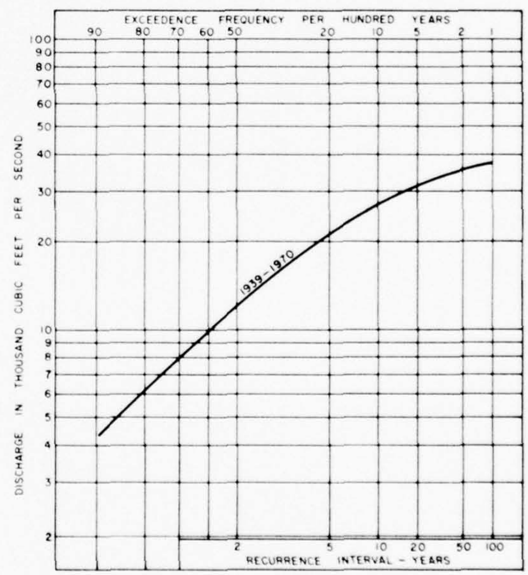


FIGURE 353 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3755 TANGIPAHOA RIVER AT ROBERT, LA.

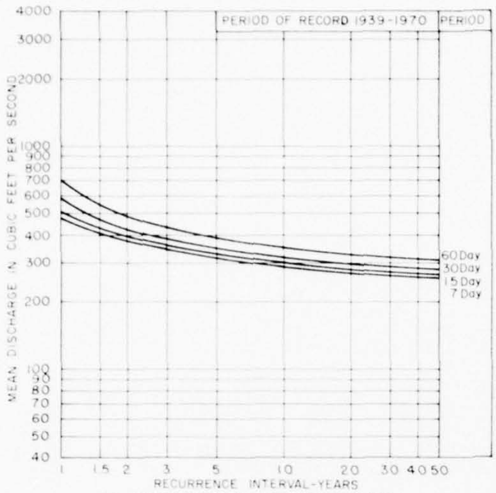


FIGURE 354 LOW FLOW FREQUENCY CURVES
7-3785 AMITE RIVER NEAR DENHAM SPRINGS, LA.

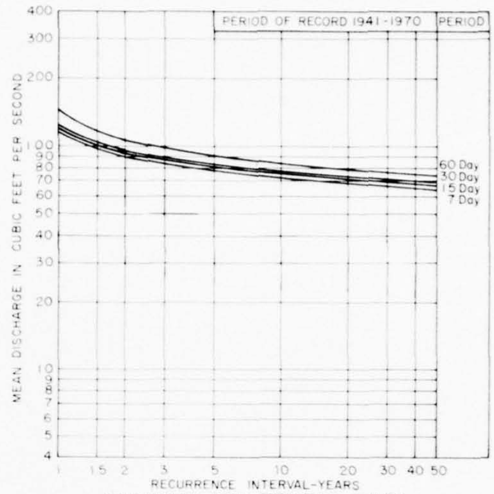


FIGURE 355 LOW FLOW FREQUENCY CURVES
7-3760 TICKFAW RIVER AT HOLDEN, LA.

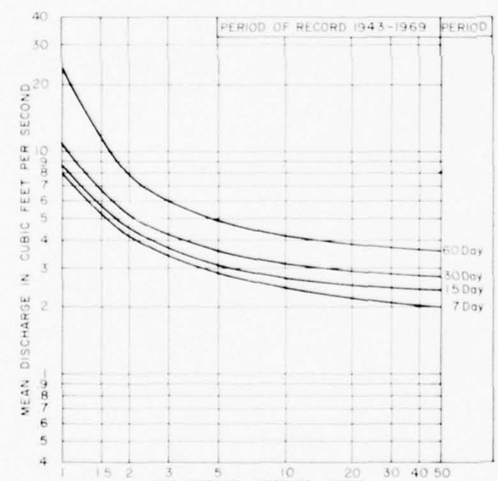


FIGURE 356 LOW FLOW FREQUENCY CURVES
7-3765 NATALBANY RIVER AT BAPTIST, LA.

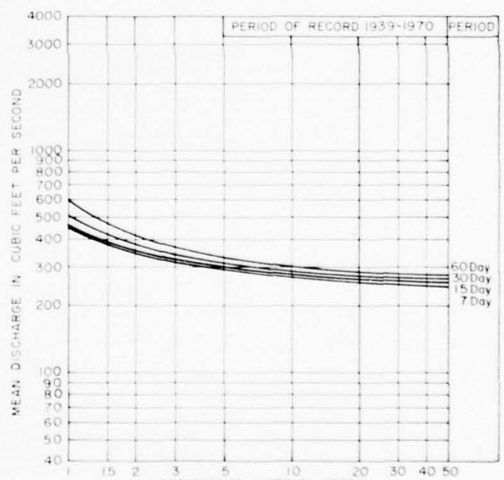


FIGURE 357 LOW FLOW FREQUENCY CURVES
7-3755 TANGIPAHOA RIVER AT ROBERT, LA.

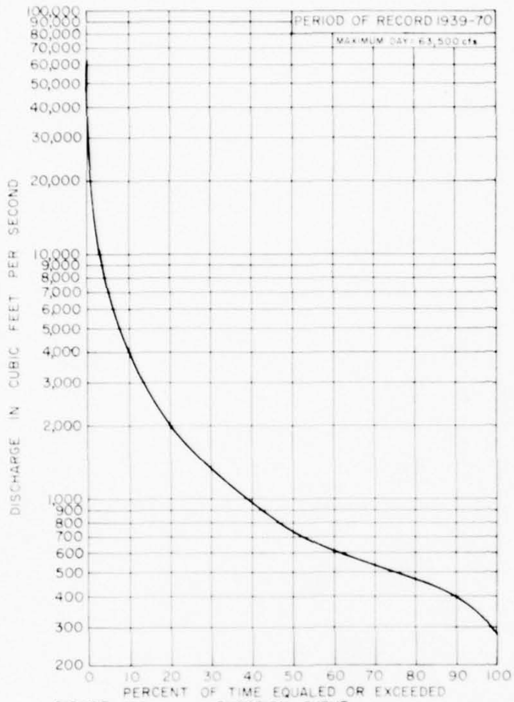


FIGURE 358 DURATION CURVE
7-3785 AMITE RIVER NEAR DENHAM SPRINGS, LA.

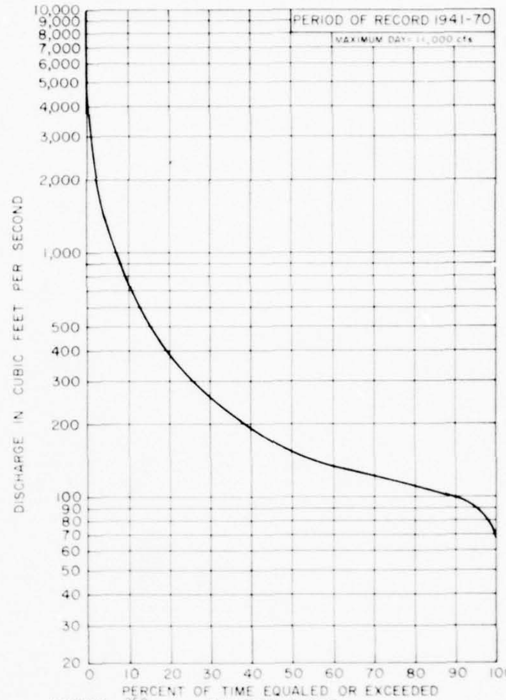


FIGURE 359 DURATION CURVE
7-3760 TICKFAW RIVER AT HOLDEN, LA.

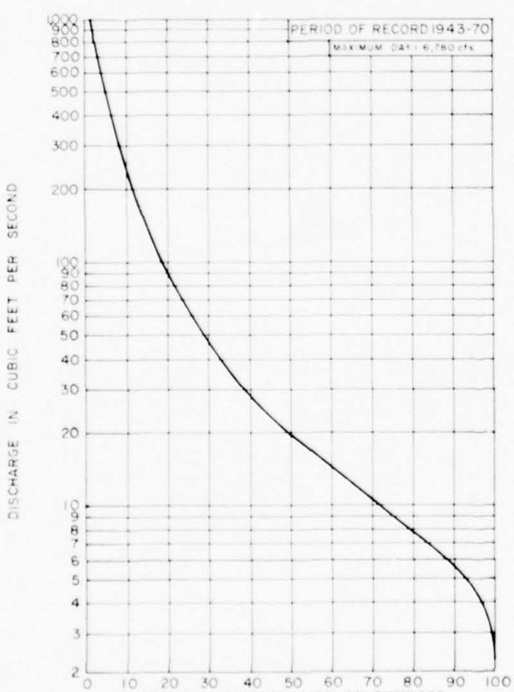


FIGURE 360 DURATION CURVE
7-3765 NATALBANY RIVER AT BAPTIST, LA.

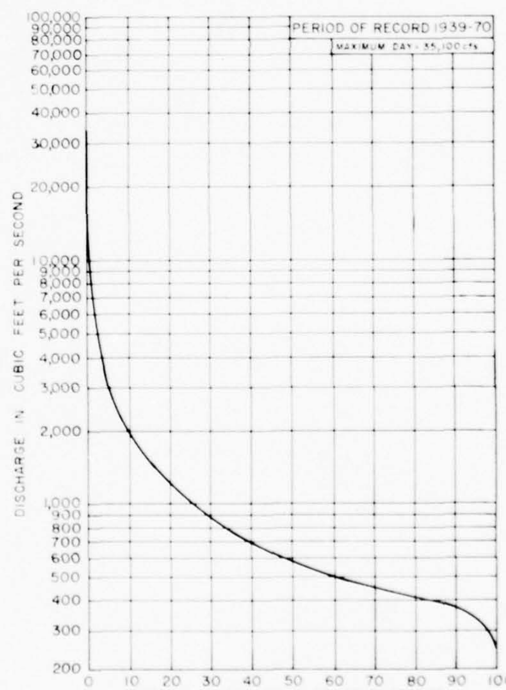


FIGURE 361 DURATION CURVE
7-3755 TANGIPAHOA RIVER AT ROBERT, LA.

Table 226 - Dependable Yield at Sta 7-3785, Amite River near Denham Springs, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1939-1970 Mean
1	1963-1963	669	36.7
2	1968-1969	1,225	67.2
3	1968-1970	1,173	64.3
4	1967-1970	1,251	68.6
5	1966-1970	1,489	81.6
6	1963-1968	1,539	84.4
7	1963-1969	1,545	84.7
8	1963-1970	1,473	80.8
9	1962-1970	1,570	86.1
10	1961-1970	1,647	90.3
32	1939-1970	1,824	100.0

Table 227 - Dependable Yield at Sta 7-3760, Tickfaw River at Holden, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1931-1970 Mean
1	1970-1970	148	43.0
2	1969-1970	216	62.8
3	1968-1970	203	59.0
4	1967-1970	218	63.4
5	1966-1970	268	77.9
6	1965-1970	278	80.8
7	1954-1970	289	84.0
8	1963-1970	271	78.8
9	1962-1970	299	86.9
10	1951-1960	308	89.5
30	1941-1970	344	100.0

Table 228 - Dependable Yield at Sta 7-3765, Natalbany River at Baptist, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1943-1970 Mean
1	1963-1963	25	23.4
2	1969-1970	56	52.3
3	1968-1970	58	54.2
4	1967-1970	62	57.9
5	1966-1970	76	71.0
6	1965-1970	77	72.0
7	1963-1969	83	77.6
8	1963-1970	77	72.0
9	1962-1970	86	80.4
10	1961-1970	94	87.9
28	1943-1970	107	100.0

Table 229 - Dependable Yield at Sta 7-3755, Tangipahoa River at Robert, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1939-1970 Mean
1	1963-1963	525	49.7
2	1967-1968	658	62.2
3	1968-1970	676	64.0
4	1967-1970	697	65.9
5	1966-1970	825	78.0
6	1965-1970	846	80.0
7	1964-1970	877	83.0
8	1963-1970	833	78.8
9	1962-1970	926	87.6
10	1951-1960	957	90.5
32	1939-1970	1,057	100.0

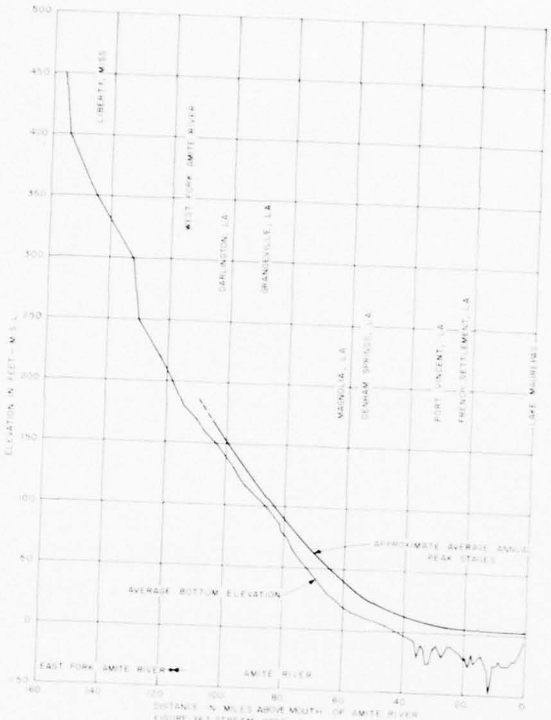


FIGURE 362 STREAM PROFILE, AMITE, LA

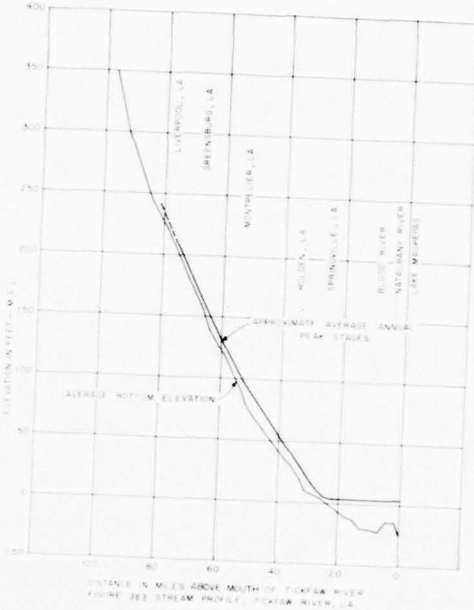


FIGURE 363 STREAM PROFILE, TICKFAW RIVER, LA

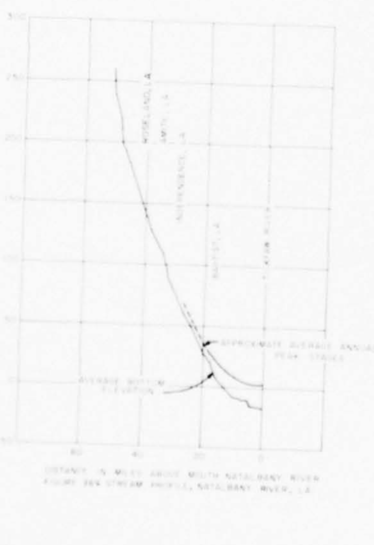


FIGURE 364 STREAM PROFILE, NATALBANY RIVER, LA

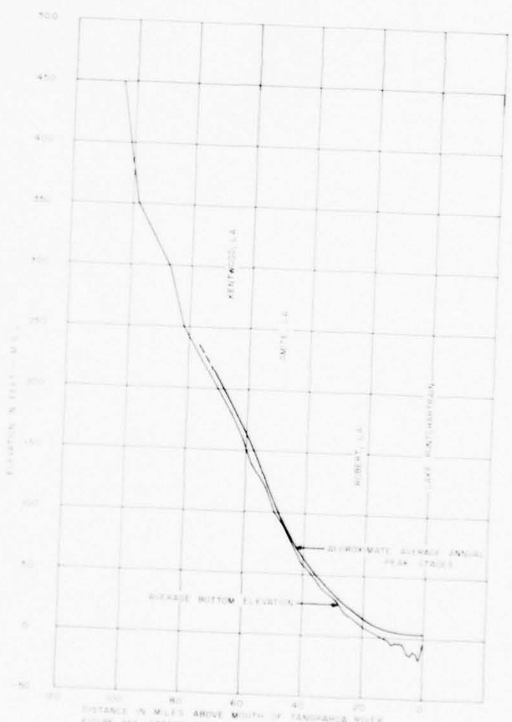
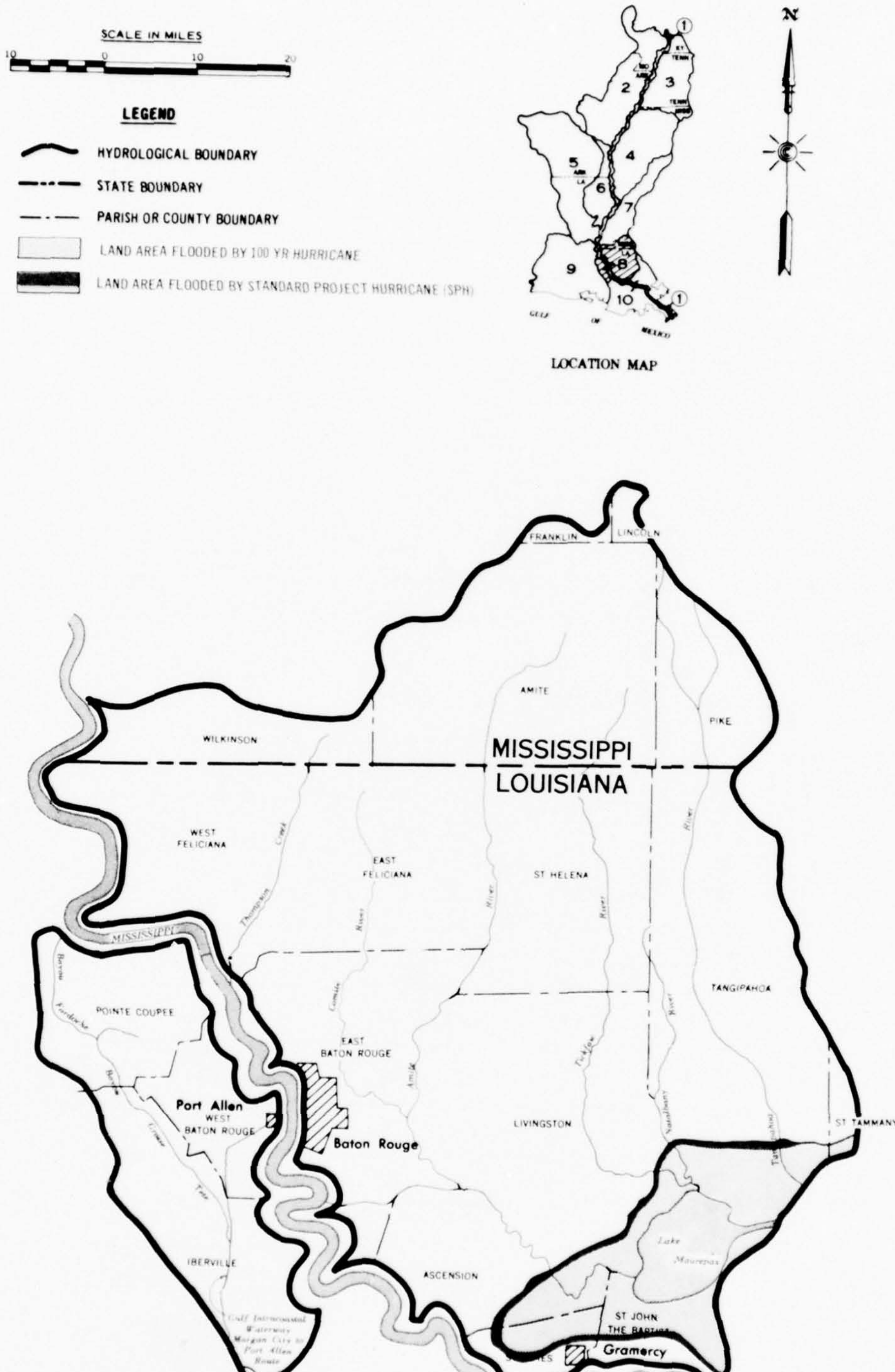


FIGURE 365 STREAM PROFILE, TANGIPAHOA RIVER, LA



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

LIMITS OF HURRICANE OVERFLOW

WRPA 8

FIGURE 366

Table 230 - Chemical Analyses of Water from Streams in WRPA 8 in the Lower Mississippi Region, Milligrams Per Liter

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
							07375500 Tangipahoa River at Robert, La.												
	12-22-70	1,460	12	0.19	3.3	0.7	6.1	2.9	16	3.6	9.1	0.0	1.1	55	11	0	65	6.4	30
	1-20-71	--	13	.18	3.7	1.9	5.1	1.1	16	4.0	7.0	.0	.6	54	17	4	54	6.6	15
	3-31-71	--	9.4	.21	3.4	.4	4.5	2.6	15	2.0	6.0	.0	1.6	65	10	0	54	6.4	60
	5-26-71	--	13	.10	2.8	1.2	6.0	1.7	17	2.8	5.9	.0	.1	51	12	0	59	6.4	15
	6-23-71	--	12	.24	2.4	1.0	5.7	.9	15	3.2	6.5	.0	.4	46	10	0	54	6.6	40
Quaternary							07378500 Amite River near Denham Springs, La.												
	10-16-70	1,570	10	0.03	2.6	0.9	2.0	4.1	11	1.0	4.0	0.0	2.0	49	10	1	44	6.1	40
	11-10-70	526	13	--	3.2	1.0	6.0	2.6	22	.0	6.5	.0	.2	47	12	0	62	6.1	0
	12-14-70	574	11	.06	3.1	1.0	4.9	3.0	19	1.8	7.2	.0	.4	48	12	0	58	6.3	30
	2-17-71	1,590	11	.09	3.0	1.1	4.1	1.7	12	4.0	5.3	.0	.8	55	12	2	48	6.3	30
	3-15-71	1,040	13	--	3.0	1.1	5.7	1.4	20	2.2	6.0	.1	.2	43	12	0	55	6.4	5
	4-19-71	522	11	.01	2.6	1.3	6.2	1.3	19	2.8	6.4	.0	.2	48	12	0	56	6.3	5
	6-11-71	511	11	--	2.7	.8	5.7	1.2	18	1.4	5.3	.1	.1	38	10	0	47	6.0	5
	7-20-71	378	13	.03	2.2	1.1	6.0	1.0	18	.6	5.8	.0	.1	37	10	0	46	6.0	10
	8-22-71	423	7.0	.04	2.9	.7	6.2	2.0	18	1.6	5.9	.0	.1	44	10	0	57	6.0	20

GROUND WATER

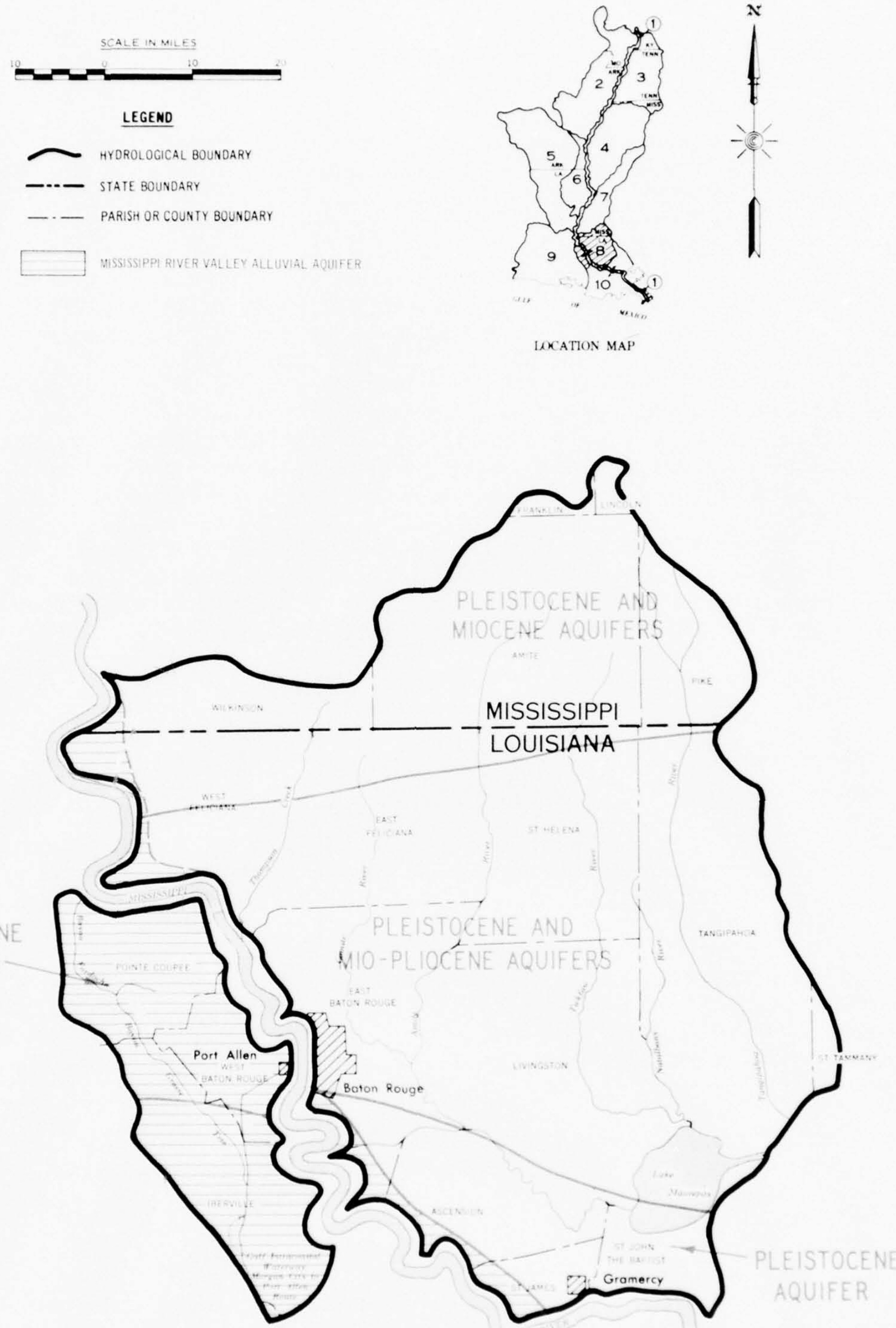
Tertiary and Quaternary deposits contain fresh ground water throughout WRPA 8 (figure 367). Artesian aquifers of Miocene and Pliocene age contain fresh water as deep as 3,500 feet below mean sea level and are overlain by Quaternary deposits, except for a small Miocene outcrop in southwestern Mississippi. Terraced Pleistocene deposits form the gently rolling hills, and Holocene deposits are the wide floodplains that characterize the area. Together, the Miocene, Pliocene, and Pleistocene deposits constitute a vast thickness of southward-dipping alternating sands and clays. Miocene and Pliocene sands are similar lithologically and are considered together in this report. Pleistocene sands are generally somewhat coarser and not as well sorted. The Mississippi River Valley alluvial aquifer is the most significant aquifer of Quaternary age and contains the only fresh water available in the extreme southern part of the area.

About two-thirds of the 210 mgd pumped in WRPA 8 is for industrial use, and almost all of this is withdrawn in the Baton Rouge area. Most of the remainder is for municipal use. Only a relatively minor amount is withdrawn for rural and agricultural purposes.

Tertiary Aquifers

The interbedded Miocene and Pliocene sands in WRPA 8 form a vast artesian aquifer system. Inasmuch as the sands are interconnected locally and are virtually identical lithologically, they are treated as a hydrologic unit in this report and are referred to as Mio-Pliocene sands for the sake of convenience. The Miocene deposits crop out in a small area in Wilkinson County, Miss., and are blanketed by Quaternary deposits to just south of the Louisiana State line, beyond which they are overlain by Pliocene beds. The Pliocene deposits are covered by Quaternary sediments and do not crop out in the area. All the Mio-Pliocene sands dip and thicken somewhat to the south. The total thickness of Mio-Pliocene deposits is many thousands of feet, but the deepest occurrence of fresh water is about 3,500 feet below mean sea level in southern Tangipahoa Parish.

The fine- to medium-grained sands are uniformly graded, but individual sands vary considerably in thickness. Pinchouts are common, and few major sands are traceable for large distances. Most major sands, that is, the thicker and more extensive sands, are in the 50- to 200-foot thickness range. Where the interbedded clays also pinch out, the resulting coalescence of sands produces locally massive sands several hundred feet thick. Coefficients of transmissibility determined from pumping tests range from 20,000 to 800,000 gpd per foot, but most are on the order of 100,000 to 300,000 gpd per foot. Transmissibilities



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

GEOLOGIC SOURCES OF GROUND WATER

WRPA 8

FIGURE 367

of 500,000 to 1,000,000 gpd per foot should be possible locally in massive sands. Flowing wells yield from a few to more than 1,000 gpm. Pumping yields vary over about the same range, and yields of 1,000 to 3,000 gpm are available in most of the area. Even higher yields may be possible by screening the full thickness of massive sands or the multiple screening of several sands.

Water in the Mio-Pliocene sands is generally soft, a sodium bicarbonate type where it is fresh, and may be corrosive. Fluoride content varies and locally exceeds recommended limits. Water with a hydrogen sulfide odor also occurs somewhat erratically. Dissolved-solids content increases downdip, and the water becomes a sodium chloride type in the extreme southern part of the area.

About 155 mgd is withdrawn from Mio-Pliocene sands, which is about 75 percent of the ground water pumped in the area. The heaviest pumpage is concentrated around the Baton Rouge area, and the resulting water level declines have spread to adjacent areas. However, water levels are still high in most of WRPA 8 to the extent that high-yield flowing wells can still be obtained in some areas. The potential for the system is more than double the present pumpage. Because of the large drawdown space available in wells, the potential yield of the system can be further increased if large pumping lifts and some subsidence are tolerable.

Quaternary Aquifers

Pleistocene Aquifers

Pleistocene deposits overlie the Miocene and Pliocene deposits and are contiguous with the Mississippi River Valley alluvial aquifer. Characteristically heterogeneous, the Pleistocene deposits are predominantly sand with interbedded clays of varying continuity and thickness; some sands are graveliferous. The sands are interconnected and function as a hydrologic unit. All the sands have not been completely flushed, and some contain salty water in the southern part of the area.

The texture of the sands in the Pleistocene aquifer is highly variable, from fine to coarse and graveliferous. The thickness also varies, but transmissibilities tend to be generally less than 200,000 gpd per foot. The sands are poorly sorted; and although a sand may be graveliferous, the presence of fine materials limits the permeability. As a result, well yields in most of the area are low to moderate--most larger wells producing a few hundred gallons per minute. Some sand beds in the southern part of the area are capable of yielding several thousand gallons per minute to wells.

Except where affected by movement of hard water from the alluvial aquifer, fresh water in the Pleistocene aquifer is generally soft, low in dissolved solids, and corrosive, although less corrosive in the

southern part of the area. Downdip, the water changes to a sodium chloride type.

The Pleistocene aquifer is capable of producing several times the present pumpage of 35 mgd. However, pumping lifts for larger wells will be somewhat high because of relatively low specific capacities. The potential for salt-water encroachment exists in downdip areas, and planning should take into account the positions of salt-water interfaces.

Mississippi River Valley Alluvial Aquifer

In addition to being contiguous with the Pleistocene aquifer, the Mississippi River Valley alluvial aquifer is in hydraulic contact with the Mississippi River. The aquifer is both Holocene and Pleistocene in age. The Holocene alluvium consists of fine sand grading finer upward to silts and clays. The coarser underlying Pleistocene material constitutes the most productive portion of the aquifer. The Mississippi River Valley alluvial aquifer is discussed separately, not because it is hydraulically independent of the main Pleistocene aquifer, but because its connection with the river gives it distinct and advantageous hydraulic characteristics.

Wells screened in the alluvial aquifer near the river can divert a large part of their discharge from the river, and large yields are feasible. The effect of recharge from the river decreases with distance from the river as does the portion of the well's discharge that represents diverted river water.

The chemical quality of water from the Mississippi River Valley alluvial aquifer has been the chief deterrent to increased development of the aquifer. The water is characteristically very hard and high in iron content.

The peculiarities of the Mississippi River Valley alluvial aquifer render its potential subject to qualifications, but tremendous amounts can be developed for users who can tolerate the water quality. The 22 mgd presently being withdrawn is only a small fraction of the amount available. Well fields can be designed whose discharge will be, in large part, induced recharge from the river; such developments can produce large quantities of water with a minimum effect on the rest of the aquifer.

Effects of Ground Water Withdrawals and Management Considerations

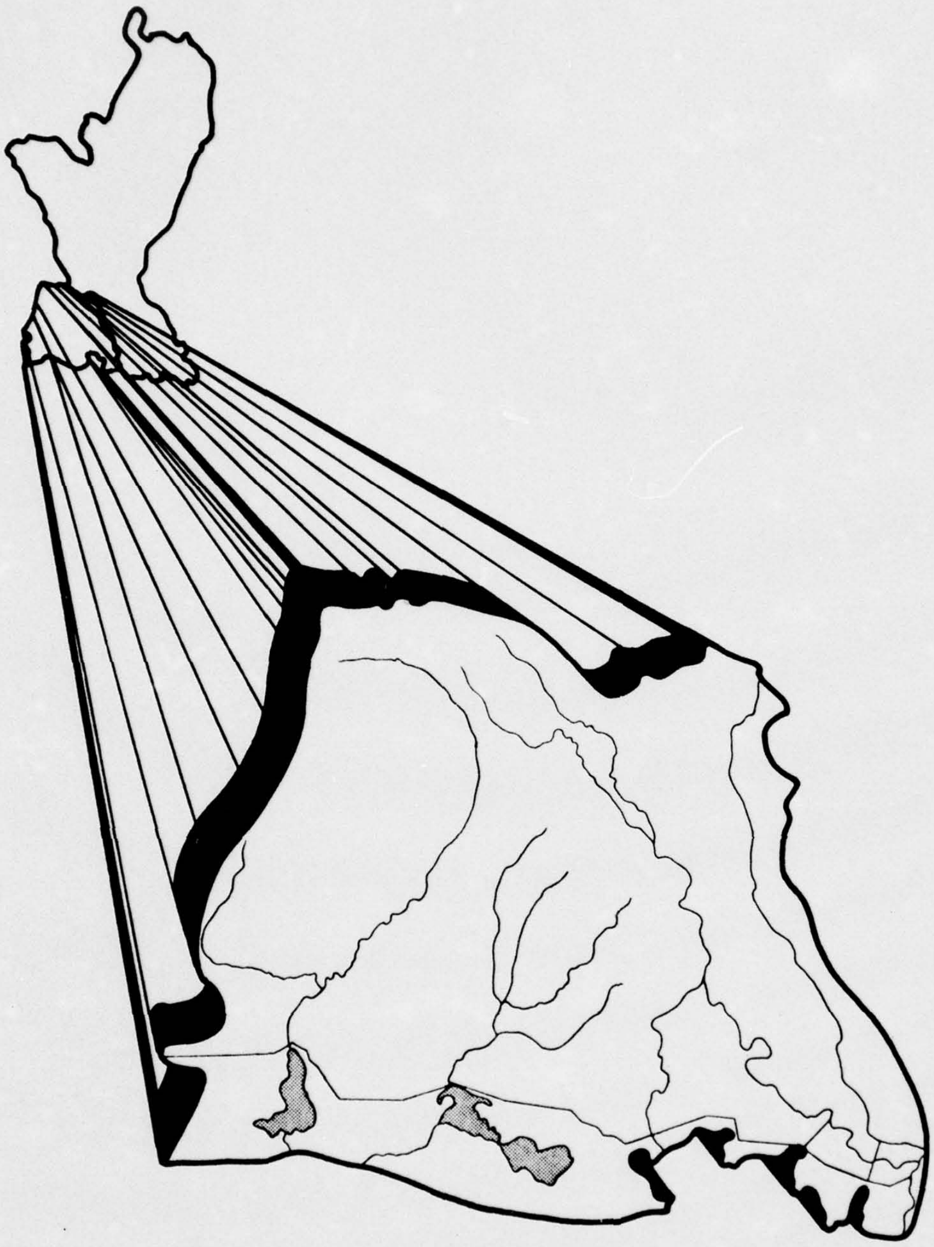
Although the sands in the aquifer systems in WRPA 8 are interconnected in places, they are sufficiently hydraulically separated that significant water level differences exist between different sands in most of the area. Water level declines have affected some sands, but

have had very little or no effect on others. Thus, declines may result in very great pumping lifts from a particular sand at a given site, whereas another sand may have higher artesian head. The declines are caused by large withdrawals by pumping and, to a lesser degree, by many uncontrolled flowing wells. In some cases, declines have stopped or water levels have recovered where users have changed to other sands.

Except for the Mississippi River Valley alluvial aquifer, all aquifers in WRPA 8 contain salty water either downdip or at depth. Therefore, the potential for salt-water encroachment exists, and, if possible, large developments should not be planned near interfaces. In addition, saline water bearing sands occur between fresh water bearing sands in part of the area, and particular care is required in well design, development, and completion.

Several hundred million gallons per day of excellent quality water requiring little or no treatment for most uses are available in WRPA 8. Much of this water is available under natural flow or with small pumping lifts. Additional vast quantities of water are available near the river to well fields using the Mississippi River alluvial aquifer; the water is very hard and high in iron content. However, the quantities available at relatively low cost make this aquifer a valuable source of water for some uses.

Studies are needed to determine the potential for ground water supplies for industrial sites along the Mississippi River in WRPA 8. More detailed studies are needed in the Baton Rouge area, which probably will continue to be the largest producer of ground water in WRPA 8.



WRPA 9

W R P A 9

INTRODUCTION

WRPA 9, an area covering 13,296 square miles and representing approximately 13 percent of the Lower Mississippi Region, lies in southwestern Louisiana. About 12,455 square miles are land, and the remaining 841 square miles are water. The area is bounded on the west by the Sabine River Basin, on the north by the Red River Basin, on the east by the East Atchafalaya Basin protection levee, and on the south by the Gulf of Mexico. Flow from WRPA 9 is discharged into the Gulf of Mexico through the five major streams of the area. The Calcasieu River, Mermentau River, Vermilion River, and Bayou Teche originate in WRPA 9; the fifth, the Atchafalaya River is a distributary of the Red and Mississippi Rivers. Tides influence about one-third of WRPA 9; during extremely low flows, from June to October, major hurricanes may raise the Gulf as much as 12 feet above mean sea level, and during the winter, strong northerly winds depress the water surface as much as 2 feet below mean sea level.

The Calcasieu River has its source in Vernon Parish and follows a southerly course for about 215 miles to discharge into the Gulf of Mexico through Calcasieu Lake and Calcasieu Pass. In the northern part of the basin, the Calcasieu River and its tributaries are clear, swiftly running streams. Below Kinder, La., the Calcasieu River channel widens from 100 to 600 feet and deepens from 3 feet to as much as 45 feet as it approaches Lake Charles, La. In this reach, the river changes from a swiftly flowing stream to a sluggish tidal stream, typical of the bayous of southwestern Louisiana. The installation of the salt-water barrier system in 1968 limited tidal influence to mile 43.1. Below Lake Charles, La., a deepwater ship channel provides navigation dimensions of 35 by 200 feet to the wharves of the Port of Lake Charles and 40 by 400 feet to the Gulf of Mexico. The principal tributaries of the Calcasieu River include Whiskey Chitto Creek, Bundick Creek, Hickory Branch, Beckwith Creek, Barnes Creek, West Fork Calcasieu River, Bayou Serpent, English Bayou, and Bayou Contraband.

The Mermentau River is formed by the confluence of Bayou Nezpique and Bayou des Cannes and flows generally in a southwesterly direction through Lake Arthur and Grand Lake and thence to the Gulf of Mexico, a distance of about 69 miles. The main Mermentau River channel differs greatly in width and depth throughout its length, except where it passes through the lakes; channel widths range from 200 to 1,200 feet, and depths range from about 3 to 50 feet. A 12- by 124-foot channel from the Intracoastal Waterway to Interstate Highway 10 in the Mermentau River, Bayou Nezpique, and Bayou des Cannes and a 12- by 200-foot channel in Lake Arthur have been authorized. The Mermentau River system is

a series of large lakes connected to Vermilion Bay on the east and Calcasieu River on the west by navigation and flood-control channels. The Mermentau River Basin is a controlled system. Four control structures, Catfish Point Control Structure, Calcasieu Lock, Vermilion Lock, and Schooner Bayou Control Structure, impound winter runoff for use during the summer irrigation season. The lock and control structures also function to protect the impounded water from contamination by saline water from the Gulf of Mexico, Calcasieu River, and Vermilion Bay. The principal tributaries of the Mermentau River are Bayous Nezpique, des Cannes, Plaquemine Brule, Queue de Tortue, and Lacassine.

The Vermilion River is formed by the confluence of Bayous Fusilier and Carencro and traverses a total distance of about 73 miles to its mouth at Vermilion Bay. It interconnects with Bayou Teche through Bayou Fusilier and Ruth Canal. Bayou Teche has its source in Bayou Courtableau at Port Barre, La., and flows in a southeasterly direction a distance of about 125 miles to its junction with the Lower Atchafalaya River, 10.5 miles above Morgan City, La. Bayou Teche is a comparatively small stream, occupying the highest part of a very large alluvial ridge. Since all local drainage is away from the stream, it functions as a flume, conveying drainage from the Bayou Rapides-Bayou Cocodrie-Bayou Courtableau-West Atchafalaya Basin protection levee borrow pit system to the Vermilion River and Lower Bayou Teche. Keystone Lock and Dam on Bayou Teche was constructed to provide a navigation channel to Arnaudville and subsequently raised to increase the diversion through Ruth Canal to Vermilion River for irrigation.

The Atchafalaya River is a distributary for water from the Red and Mississippi Basins. It carries all the flow of the Red River and a substantial portion of the Mississippi River southward for about 55 miles. Under the 1928 Flood Control Act and amendments, a central channel was dredged from about mile 55 to Grand Lake. Later improvements have enlarged and extended the central channel to Stouts Pass. Flow from the Lower Atchafalaya Basin empties via Wax Lake Outlet and the Lower Atchafalaya River into the Atchafalaya Bay. The Atchafalaya River and Central Channel have a total length of about 135 miles. The main channel varies in width from 200 to 400 feet and in depth from 15 to 160 feet. Flow from the Mississippi River is regulated by the Old River Control Structure, which was constructed to prevent the Atchafalaya River from capturing the Mississippi River.

The Gulf Intracoastal Waterway traverses WRPA 9 from east to west along the northern fringe of the coastal marshes; three locks, the Calcasieu, Vermilion, and Bayou Boeuf, prevent salt-water intrusion and interflow between basins. There are no major tributaries below the Intracoastal Waterway in WRPA 9.

SURFACE WATER

Quantity

The average annual discharge of all streams originating in WRPA 9 into the Gulf of Mexico is about 14,500 c.f.s., or about 1.4 c.f.s. per square mile. About 30 percent of this flow originates in the salt to brackish marshes bordering on the Gulf of Mexico.

Present Utilization

Withdrawals from fresh surface water sources in WRPA 9 during 1970 averaged about 4,380 c.f.s., or about 98 percent of the total surface water withdrawal. The remaining 2 percent, or 80 c.f.s., was withdrawn from brackish water sources and used chiefly for industrial purposes. Major uses of surface water withdrawals were for industrial purposes (about 1,650 c.f.s.) and irrigation (1,176 c.f.s.).

Ground water withdrawals during 1970 in WRPA 9 averaged about 1,845 c.f.s. Major withdrawals were for irrigation (1,080 c.f.s.) and for industrial purposes (370 c.f.s.).

During 1970, about 2,625 c.f.s., or 42 percent of the total surface and ground water withdrawals from WRPA 9, was consumed. The remaining withdrawals of 3,600 c.f.s. were released and returned to nearby streams. These releases resulted in a net decrease to the area's streamflow of about 780 c.f.s. Major consumptions of water in the area were for purposes of irrigation (1,440 c.f.s.) and fish and wildlife enhancement (620 c.f.s.). Major nonconsumptive uses were for fishing, boating, and related water sports.

Table 15 of the Regional Summary presents additional data on the present withdrawals and utilization of water in WRPA 9 during 1970.

Stream Management

The major purposes for management of streamflow in WRPA 9 are irrigation, flood control, and industrial usage. In the tributary basins, emphasis is almost entirely on irrigation.

Impoundments. Reservoirs having a total capacity of 5,000 acre-feet or more are listed in table 231.

Diversions. Most of the diversions of streamflow in WRPA 9 are for irrigation, while others are for municipal, industrial, and drainage uses.

Channel modifications. Channel modification, consisting of channel enlargement, clearing, and snagging, has taken place on the five major streams in WRPA 9.

Table 231 - Reservoirs Having a Total Capacity of 5,000 Acre-Feet or More, WRPA 9

Name	Stream	Total Storage (acre-feet)	Surface Area (acres)	Purpose 1/
Bundick	Bundick Creek	9,200	1,750	R
Cocodrie		11,000	6,100	R
Chicot		9,700	1,626	R

1/ R - Recreation.

Navigation. One of the most important uses of water in WRPA 9 is for navigational purposes. Deep water navigation is provided on the Calcasieu River; inland water navigation is provided on the Mermentau River, Vermilion River, Bayou Teche, Atchafalaya River, and Gulf Intracoastal Waterway.

Streamflow

In this study, the various periods of flow that were used for the selected gaging stations were determined based on the availability of discharge data at the sites.

Measurement facilities. Streamflow data at four sites in WRPA 9 were selected for presentation in this section. Because of tidal influences, daily discharge records were available only for the headwater areas of the principal streams; however, daily stage records were available from stations located within the areas of tidal influence. The locations of these sites are shown in figure 368, and are identified by U. S. Geological Survey and Corps of Engineers station numbers. A summary of the controlling agency, drainage area (where available), period of record, gage datum, and other pertinent data for each of these stations is given in table 232.

Average discharge for WRPA 9. Figure 368 presents isopleths showing the mean annual runoff for the northern part of WRPA 9. (Mean annual runoff values for the southern part were not available because of tidal influence.) Streams originating in WRPA 9 have an estimated average annual discharge of about 14,500 c.f.s. The Atchafalaya River has an average annual discharge of about 186,500 c.f.s.

Average discharge for selected stations. Observed mean discharges by months for selected gaging stations are given in tables 233-236.

Figures 369-372 are graphical representations of the average monthly discharge for selected discharge sites. The figures also

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

MEAN ANNUAL RUNOFF IN INCHES

WRPA 9

FIGURE 368

Table 232 - Streamflow Data for Water Resources Planning Area 9

Stream	Station	Station No.	Gage Datum (feet)	Drainage Area (sq. mi.)	Period of Record	Mean (c.f.s.)	Gage Readings (feet) Maximum	Gage Readings (feet) Minimum	Momentary Flow (c.f.s.) Maximum	Momentary Flow (c.f.s.) Minimum	Agency
				Calcasieu River Basin							
Calcasieu River	Near Glenmora	8-0130.0	110.77	499	43-70	697	21.6	3.9	59,000	15	USGS
Calcasieu River	At Oakdale	73040	83.00		86-66		22.6	11.2			USWB
Calcasieu River	Near Oberlin	73050	39.43	753	22-24 38-70	1,125	26.5	1.7	72,800	30	CE-USGS
Calcasieu River	Near Kinder	8-0155.0	11.95	1,700	22-70	2,493	32.0	2.0	182,000	136	USGS
Calcasieu River (SWB) 1/	Lake Charles (Nav. E)	73472	-0.78		68-70		3.8	-0.4			
Calcasieu River (SWB) 1/	Lake Charles (Nav. W)	73473	-0.78		68-70		4.0	-1.0			CE
Calcasieu River (SWB) 1/	Lake Charles (Fldy. E)	73476	-0.78		68-70		3.8	-0.4			CE
Calcasieu River (SWB) 1/	Lake Charles (Fldy. W)	73478	-0.78		68-70		3.8	-0.4			CE
Calcasieu River (SWB) 1/	Lake Charles (above SWB) 1/	73460	-0.78		69-70		2.5	1.8	2/		CE
Calcasieu River	Old Town Bay	USWB	0.00	2,224	50-68		16.1	-1.5			USWB
Calcasieu River (Moss Bluff)	North of Lake Charles	73350	0.00		47-56		7.8	0.3	2/		CE
Calcasieu River	Lake Charles	73350	0.00		55-70		4.9	-0.5	2/		CE
Calcasieu Lock West	Near Lake Charles	76950	-1.60		51-70		8.8	-0.8			CE
Calcasieu River	At Hackberry	73600	-0.55		43-70		7.2	-1.5			CE
Calcasieu River	Near Cameron	73650	-0.78		39-70		12.9	-3.1			CE
Tenmile Creek	Near Elizabeth	8-0142	94.38	94.2	49-65 66-68	124	21.3	2.0	31,900	7.2	USGS
Sixmile Creek	Near Sugartown	8-0140	82.16	171	56-65 66-68	245	17.7	1.6	21,600	34	USGS
Bayou Serpent (North Branch)	Near Fenton	73150	0.00		55-57 61-67		28.0	23.0	2/		CE
Bayou Serpent (South Branch)	Northeast of Fenton	73200	0.00		55-57 61-67		28.0	16.7	2/		CE
Bayou Serpent	Near Hecker	73250	0.00		55-62		15.1	2.6	2/		CE
Small Branch	Near Hecker	73300	0.00		55-56, 61,62,67		15.1	11.9	2/		CE
Beckwith Creek	Near DeQuincy	8-0164	25.29	148	45-70	193	24.4	0.9	13,800	0.1	USGS
Bearhead Creek	Near Starks	8-0168	16.34	177	54-70	226	17.0	7.0	8,000	0	USGS
Calcasieu River and Pass	Near Lake Charles	73550	-0.59		37-70		9.8	-1.4			CE
Calcasieu River	At Goosport	73500	0.00		60-70		6.6	-1.5			
Calcasieu Lock (IWW) 3/	Near Lake Charles	76920	-1.60		51-70		9.0	-0.7			CE
Whiskey Chitto Creek	Near Oberlin	8-0145	46.24	510	39-68	799	32.8	2.7	144,000	88	USGS
Jim Burney Tributary at Smithhart Pond	Dry Creek	8-0149	120.98	0.28	56-61		4.4	2.5	110	0	USGS
Bundick Creek	Near DeRidder	8-0148	113.75	120	56-70	151	20.8	1.9	7,090	8.8	USGS
Bundick Creek	Near Dry Creek	8-0150	56.92	238	39-70	359	23.7	1.6	37,000	20	USGS
Bayou Serpent	Near Fenton	73100	0.00		62-70		28.2	9.4			CE
West Fork Calcasieu	Near Lake Charles	73450	0.00		46-70		12.8	-2.1			CE
Houston River	Near Sulphur	73400	0.00		56,57,58, 61,62,69		11.6	3.0	2/		CE
English Bayou	Near Lake Charles	8-0160	0.00		54-68		13.5	-1.9			USGS
				Mermentau River Basin							
Bayou Nezpique	Near Basile	70075	3.39	527	38-70	757	34.4	1.0	35,800	0.1	CE-USGS
Bayou Des Cannes	Near Eunice	70150	14.84	131	38-70	252	22.4	0.9	11,900	0.0	CE-USGS
Bayou Plaquemine Brule	Near Crowley	70225	0.00	252	42,47,48, 49,65,70		28.8		14,100	0.0	CE
Bayou Plaquemine Brule	At Esterwood	70300	-0.78		47-70		20.6	-2.1			CE
Bayou Queue de Tortue	At Premeaux Pumping Plant	70450	-0.78		41-70		9.8	-1.2			CE
Bayou Queue de Tortue	At Riceville	70440	0.00		55-57 67-70		7.6	0.4	2/		CE
Mermentau River	At Mermentau	70375	-0.78		46-70		14.5	-0.9			CE
Mermentau River	Near Lake Arthur	70525	-0.78		56-70		6.6	-0.2			CE
Mermentau River	At Lacassine Refuge	70600	-0.78		47-70		6.3	-0.5			CE
Mermentau River (North)	At Catfish Point Control Structure	70675	-0.78		51-70		8.3	-0.7			CE
Mermentau River (South)	At Catfish Point Control Structure	70750	-0.78		49-70		8.3	-1.5			CE
Mermentau River	At Grand Cheniere	70900	-0.78		43-54 56-70		13.0	-0.9			CE
Schooner Bayou (East)	At Control Structure	76600	-0.78		17-70		6.6	-2.9			CE
Schooner Bayou (West)	At Control Structure	76680	-0.78		17-70		6.0*	-1.7			CE
Intracoastal Waterway	At Vermillion Lock (E)	76720	-0.78		32-70		8.9	-2.9			CE
Intracoastal Waterway	At Vermillion Lock (W)	76800	-0.78		33-70		8.9	-1.9			CE
Intracoastal Waterway	At Calcasieu Lock (E)	76880	-1.59		51-70		6.6	-0.4			CE
Intracoastal Waterway	At Calcasieu Lock (W)	76960	-1.59		51-70		8.8	-0.8			CE
Pecan Island Canal	Near White Lake	N-93-B	-0.78		50-60		8.1	0.0			CE
				Teche-Vermilion Basin							
Bayou Teche	Port Barry	64050	0.00		32-70		28.3	10.3			CE
Bayou Teche	Below Little Bayou Teche	T-C	0.00		33-40		31.2	11.1			CE
Bayou Teche	Leonville	T-S	0.00		40-46		19.8	14.9			CE

1/ SWB - Salt water barrier.
2/ Maximum and minimum gage readings from intermittent discharge records.
3/ IWW - Intercoastal waterway.

Table 232 - Streamflow Data for Water Resources Planning Area 9 (Con.)

Stream	Station	Station No.	Gage Datum (feet)	Drainage Area (sq. mi.)	Period of Record	Mean (c.f.s.)	Gage Readings (feet) Maximum	Gage Readings (feet) Minimum	Momentary Flow (c.f.s.) Maximum	Momentary Flow (c.f.s.) Minimum	Agency
			Teche-Vermilion Basin (Con.)								
Bayou Teche	Arnaudville	7-3855.0	0.00	1,531	49-70	811	24.3	6.8	4,630	53	USGS
Bayou Teche	Keystone Lock (Upper)	64200	-0.78		13-70		24.3	0.8			CE
Bayou Teche	Keystone Lock (Lower)	64250	-0.78		13-70		24.3	-0.7			CE
Bayou Teche	Keystone Lock	7-3857.0	-0.78		59-70	430	15.6	9.5	3,590	0	USGS
Bayou Teche	Arnaudville	64100	0.00		32-70		24.3	6.8			CE
Bayou Teche	Below Ruth Canal	T-R	-0.78		38-53		14.5		2/		CE
Bayou Teche	Above Loreauville Canal	64300	0.00		33-70		8.1	0.4	2/		CE
Bayou Teche	Hwy Bridge N. of NI&N RR	T-M	0.00		33-40		5.3		2/		CE
Bayou Teche	West Calumet Floodgate	64650	-0.10		51-70		4.3	-2.2			CE
Bayou Vermilion	Tontons Bridge	67150	-0.78		47-70		21.1	-0.4			CE
Bayou Vermilion	Pont Des Mouton	T-Z	-0.78		48-54		13.2	1.3			CE
Bayou Vermilion	Long Bridge	67225	-0.78		37-70		20.4	-1.0			CE
Bayou Vermilion	Hyw 422 Bridge	T-Y	-0.78		46-52		13.2	0.6	2/		CE
Bayou Vermilion	Junction Ruth Canal	N-84	-0.78		37-58		20.2	0			CE
Vermilion River	Lafayette	V-F	-0.78		47-49		12.1	0.5	2/		CE
Vermilion River	Pin Hook Bridge	V-A	-0.78		41-60		14.7	-1.0			CE
Vermilion River	Surrey Avenue Bridge	67375	-2.27		61-70		13.7	0.6			CE
Vermilion River	Broussard Bridge	67450	-0.78		48-70		13.6	-1.7			CE
Vermilion River	Landry Bridge near Milton	N-86	-0.78		41-51		14.5	-1.3			CE
Vermilion River	Milton	67600	-0.78		41-70		12.5	0.0	2/		CE
Vermilion River	Abbeville	67675	-0.78		41-70		10.6	-0.3	2/		CE
Vermilion River	Abbeville Pumping Plant	67825	-0.78		31-70		13.5	-2.3			CE
Vermilion River	Near Bancker	67875	-0.78		63-70		4.7	-2.2			CE
Vermilion River	Junction with Little Bayou	N-88	-0.78		47-51		4.1	1.4			CE
Vermilion River	Intracoastal Waterway	67900	-0.78		32-63		7.7	-2.6			CE
Vermilion River	Onion Bayou	N-90	-0.78		45-51		5.4	-2.2			CE
Bayou Bourbeau	Shuteston	7-3865.0	27.14	19	42-70	25.8	10.8	1.4	2,840	0	USGS
Bayou Bourbeau	Frozard	T-CC	-0.78		47-53		20.9	9.7	2/		CE
Bayou Fusilier	Arnaudville	67075	0.00		46-70		24.1	8.3	2/		CE
Bayou Carencro	Sunset	T-GG	12.8	37.1	43-64		17.1	0	2/		CE
Bayou Carencro	State Highway 771 N. Stokey	--	-0.78		47-49		18.6	9.1	2/		CE
Ruth Canal	Ruth Control Structure E	64150	0.00		38-70		18.4	5.2			CE
Ruth Canal	Ruth Control Structure W	67300	0.00		38-70		18.5	0			CE
Ruth Canal	Ruth, East of Structure	7-3867.0	0.00		59-70	162	17.4	7.4	802	18	USGS
Coulee Mine	South of Lafayette	V-H	-0.78		47-55		15.4	2.3	2/		CE
Coulee Kinney	Above SPRR W. of Abbeville	V-I	-0.78		47-51		8.8	-1.0			CE
Coulee Kinney	At SPRR W. of Abbeville	67750	-0.78		47-70		8.5	1.0	2/		CE
Intracoastal Waterway	Vermilion Lock East	76720	-0.78		32-70		8.9	-2.9			CE
Coulee Ile des Cannes	Near Maurice	V-G	-0.78		47-61		17.5	1.1	2/		CE
Delcambre Canal	Above Hwy 14 Delcambre	T-FF	0.00		48-60		6.6	-3.2			CE
Delcambre Canal	Below Hwy 14 Delcambre	79500	0.00		48-70		7.0	-3.2			CE
Bayou Boeuf	Kincaid	D-AC	0.00		51-62		81.7	75.1			CE
Bayou Boeuf	Near Woodworth	61250	0.00		39-42 62-70		72.4	62.4			CE
Bayou Boeuf	Twin Bridges	61240	0.00		46-63		74.6	68.4			CE
Bayou Boeuf	#3 West of Chambers	D-HH	0.00		49-49		69.8	59.6			CE
Bayou Boeuf	#4 Near Lamourie	61280	0.00		37-70		72.4	59.2			CE
Bayou Boeuf	Above Junction with Middle Bayou	D-II	0.00		39-43		73.5	71.4			CE
Bayou Boeuf	Near Lecompte	61400	0.00		48-70		71.8	59.0			CE
Bayou Boeuf	Lecompte	61480	0.00		46-70		70.3	58.9	2/		CE
Bayou Boeuf	At T&P RR, Lyles	D-JJ	0.00		39-54		68.9	55.7			CE
Bayou Boeuf	Meeker	61800	0.00		54-70		66.8	58.3			CE
Bayou Boeuf	Below B. Rapides Control Structure	61120	0.00		57-70		67.2	63.2	2/		CE
Bayou Cocodrie	Near Clearwater	7-3820	40.0	240	37-70	404	26.7	3.3	28,200	50	USGS
Bayou Cocodrie	Dossman	61680	0.00		37-50 61-70		48.8	34.2	2/		CE
Bayou Cocodrie	St. Landry	61720	0.00		46-70		48.8	33.5			CE
Bayou Cocodrie Div. Channel	Milburn	61600	0.00		49-70		49.3	26.8			CE
Bayou Cocodrie	Whiteville	61760	0.00		46-70		42.3	19.0			CE
Spring Creek	Near Glenmora	7-3818.0	63.3	68.3	54-70	88	20.5	4.6	6,120	27	USGS
Bayou Wauksha	Near Lebeau	58240	0.00	95	69-70						CE
Bayou Courtableau	Washington	7-3825.0	0.00	715	46-70	990	35.3	10.7	9,490	71	USGS
Bayou Courtableau	Port Barre (East Gage)	58250	0.00		32-70		27.9	10.8	2/		CE
Bayou Courtableau	Courtableau	58350	0.00		32-70		24.8	10.6			CE
Bayou Courtableau	East Connecting Drainage Ditch	CO-P	0.00		36-44		22.6	14.3	2/		CE
Bayou Courtableau	West Connecting Drainage Ditch	CO-Pb	0.00		38-44		22.6	14.3	2/		CE
Bayou Courtableau	200 feet below West Weir	CO-Oa	0.00		49-54		24.3	17.9	2/		CE
Bayou des Glaises	Diversion Channel Moreauville	7-3835.0	23.46	270	43-70	410	22.7	2.8	6,340	3	USGS
West Protection Levee Borrow Pit	Near Plaucheville		18.54	321	44-57	529	22.9	1.9	6,130	4	USGS
West Protection Levee Borrow Pit	North of T&P RR	D-BB	0.00		38-40		28.3	21.2	2/		CE

2/ Maximum and minimum gage readings from intermittent discharge records.

Table 232 - Streamflow Data for Water Resources Planning Area 9 (Con.)

Stream	Station	Station No.	Gage Datum (feet)	Drainage Area (sq. mi.)	Period of Record	Mean (c.f.s.)	Gage Readings (feet) Maximum	Gage Readings (feet) Minimum	Momentary Flow (c.f.s.) Maximum	Momentary Flow (c.f.s.) Minimum	Agency
Teche-Vermilion Basin (Con.)											
Bayou Courtableau	Outlet Channel Sta 32+00	46900	0.00		56-70		19.9	10.4	2/		CE
West Protection Levee Borrow Pit	Palmetto	58100	0.00		46-70		30.9	11.4	2/		CE
West Protection Levee Borrow Pit	New Henderson Landing	58600	0.00		32-70		18.4	-1.0			CE
West Protection Levee Borrow Pit	RR Bridge at Henderson	C-H	0.00		35-38		10.9	0.5	2/		CE
West Protection Levee Borrow Pit	Drainage Canal at RR Bridge	C-K	0.00		34-37		10.0	1.3	2/		CE
West Protection Levee Borrow Pit	Near Courtableau	58550	0.00		40-70		23.6	-0.2			CE
Catahoula Lake	Catahoula	58650	0.00		32-70		15.8	-1.0			CE
West Protection Levee Borrow Pit	East of Catahoula	N-69	0.00		34-49		11.1	-0.2			CE
West Protection Levee Borrow Pit	Lower Grand Bayou	58700	0.00		36-70		8.6	-0.3			CE
Charenton Drainage Canal	Below Floodgate	64400	0.00		43-70		7.3	-1.4			CE
Charenton Drainage Canal	SPRR Trestle Baldwin	64450	-0.26		41-70		5.4	-1.5			CE
Charenton Drainage Canal	Mud Lake	64500	0.00		58-68		5.2	-2.5			CE
Bayou Lamourie	Below Control Structure	61320	0.00		37-70		70.1	58.9	2/		CE
Chatlin Lake Canal	Near Lecompte	7-3830	40.00	75.9	42-70		22.5	4.0	2,600	4.0	USGS
Chatlin Lake Canal	Near Cheneyville	55025	0.00		57-70		55.7	40.4			CE
Fish Lake	Near Cheneyville	55050	0.00		57-70		54.8	45.0	2/		CE
Bayou Wilson	Near Cheneyville	55100	0.00		57-70		55.1	45.1	2/		CE
Bayou Rapides	East of Philip Bayou	D-GG	0.00		39-47		79.8	60.0	2/		CE
Bayou Rapides	Lamothe	D-TT	0.00		46-52		81.4	74.5	2/		CE
Bayou Dulac	Near Hessmer	55200	0.00		37-70		54.3	37.0			CE
Three Prong Lake	Belledeau	55150	0.00		39-70		56.2	40.7			CE
Coulee des Grues	South of Marksville	55550	0.00		32-70		59.7	41.7			CE
Mill Bayou	#1 near Lake Roseau	55300	0.00		45-70		44.1	37.1	2/		CE
Mill Bayou	#2 near Hamburgh	55350	0.00		45-70		41.8	34.1	2/		CE
Mill Bayou	#3 RR Bridge Hamburgh	55400	0.00		45-70		42.8	33.3	2/		CE
Bayou des Glaises	Moreauville	D-U	0.00		37-52		52.3	30.0			CE
Bayou des Glaises Diversion Channel	Moreauville	7-3835.0	23.46	270	43-70	410	22.7	3.6	6,340	3.0	USGS
Bayou des Glaises Diversion Channel	At Head Moreauville	D-FF	0.00		39-55		45.8	32.3	2/		CE
Loreauville Canal	Near New Iberia	64350	0.00		33-70		7.2	0.4	2/		CE
West Atch. Basin Protection Levee (LS) 4/	Bayou Rouge	58050	0.00		37-70		33.2	9.8			CE
Big Darbonne Bayou (FWS) 5/	Courtableau	46300	0.00		32-70		25.9	10.5			CE
Big Darbonne Bayou (LS) 4/	Courtableau	58200	0.00		32-70		25.6	10.5			CE
Bayou Courtableau	Drainage Structure (LS) 4/	58450	0.00		57-70		20.1	10.6			CE
Bayou Courtableau (FWS) 5/	Drainage Structure (FWS) 5/	46600	0.00		57-70		19.8	9.2			CE
Hanson Canal	Hanson Lock (N)	64550	-0.78		23-51 51-70 6/		10.9	-2.3			CE
Wax Lake (West)	Control Structure (N)	76520	0.00		55-70		2.1	-2.3			CE
Wax Lake (West)	Control Structure (S)	76560	0.00		55-70		7.4	-2.4			CE
Freshwater Canal	Above Beef Ridge	76590	-0.78		63-70		3.7	-1.6			CE
Freshwater Canal (N)	Freshwater Bayou Lock	76592	-0.78		68-70		3.4	-1.6			CE
Freshwater Canal (S)	Freshwater Bayou Lock	76593	-0.78		68-70		4.0	-2.0			CE
Bayou Cocodrie Div. Channel	Near Eola	61560	0.00		58-70		45.4	29.6			CE
Bayou Cocodrie Div. Channel	Near Lonepine	61520	0.00		56-70		60.9	40.0			CE
Bayou des Glaises	Near Cottonport	55250	0.00		55-70		49.9	35.3			CE
Atchafalaya River Basin											
Old River Outflow Channel	Near Knox Landing	02100	0.00	1,128,700	61-70		47.8	1.3	390,000	32,000	CE
Old River	Torras (Lock Tailbay)	02750	0.00		63-70		43.4	1.2			CE
Atchafalaya River	Barbre Landing	03015	3.81		80-70		57.7	-2.8			CE
Atchafalaya River	Simmesport	03045	5.73		92-70	167,000	53.4	-4.7	661,00	10,500	CE
Atchafalaya River	Melville	03060	0.18		85-70		46.8	0.7			CE
Atchafalaya River	Krotz Spring	03075	0.00		12-70		38.5	1.0			CE
Atchafalaya River	Krotz Spring	7-3815	0.00		34-64	169,300	39.0	1.1	624,000	17,400	USGS
Atchafalaya River	Atchafalaya	03090	-0.16		31-70		30.4	1.3			CE
Atchafalaya River	Butte LaRose	03120	-0.30		28-70		27.3	1.2			CE
Whiskey Bay Pilot Channel	Below Head	03240	0.00		58-70		30.1	1.1			CE
Blind Tensas Cut	Below Upper Grand River	03315	0.00		58-70		22.7	1.0			CE
Chicot Pass	West Fort Chicot Pass	03465	0.00		59-70		14.7	1.7			CE
Chicot Pass	Near Myette Point	03540	0.00		63-70		11.6	0.4			CE
WABPL (FWS) 5/	Bayou Rouge	46150	0.00		37-70		29.8	12.3			CE

2/ Maximum and minimum gage readings from intermittent discharge records.
4/ LS - Landside.
5/ FWS - Floodway side.
6/ Intermittent gage record.

Table 232 - Streamflow Data for Water Resources Planning Area 9 (Con.)

Stream	Station	Station No.	Gage Datum (feet)	Drainage Area (sq. mi.)	Period of Record	Mean (c.f.s.)	Gage Readings (feet) Maximum	Gage Readings (feet) Minimum	Momentary Flow (c.f.s.) Maximum	Momentary Flow (c.f.s.) Minimum	Agency
Atchafalaya River Basin (Con.)											
State Canal	Near Krotz Springs	7-38440	2.55		60-70		18.0				USGS
Big Darbonne Bayou (FWS) 5/	Courtableau	46300	0.00		32-70		25.9	10.5			CE
WABPL Borrow Pit (FWS) 5/	Near Courtableau	46375	0.00		32-70		26.0	10.9			CE
Bayou Courtableau Outlet Channel	Near N.E. Wing Wall	46600	0.00		57-70		19.8	9.2			CE
Bayou Courtableau Outlet Channel	Near S.E. Wing Wall	46750	0.00		57-70		19.8	9.3			CE
Bayou Courtableau Outlet Channel	Sta 225+00 E. Auto.	49075	0.00		59-70		19.9	9.4			CE
Bayou Fordoche	Near Krotz Springs	49255	0.00		54-70		20.0	10.3			CE
WABPL (FWS) 5/	Cleon	49120	0.00		34-45 57-70		25.6	4.0			CE
WABPL Borrow Pit (FWS) 5/	Opelousas Bay	49135	0.00		35-39 69-70		25.6	3.9 6/			CE
WABPL Borrow Pit (FWS) 5/	Bayou Mersier	49150	0.00		45-70		22.9				CE
WABPL Borrow Pit (FWS) 5/	Lower Grand Bayou	49195	-0.45		33-70		17.2	0.3			CE
Grand Lake	Charenton	03555	-0.94		32-70		12.9	-0.9			CE
Sixmile Lake	Near Verdunville	03645	0.00		33-70		9.0	-2.2			CE
Wax Lake Outlet	Calumet	03720	-0.14		42-70		8.4	-2.7			CE
Lower Atchafalaya River	Berwick Lock (E)	03765	0.00		55-70			6/			CE
Lower Atchafalaya River	Morgan City	03780	-2.94		05-70		11.4	-2.5	741,000		CE
Bayou Boeuf	Bayou Boeuf Lock (W)	76400	-0.78		54-70		9.2	-1.2			CE
IWW Wax Lake (E)	Control Structure	76440	0.00		55-70		8.5	-2.1			CE
Lower Atchafalaya River	Below Sweet Bay Lake	03820	0.00		56-70		8.0	-1.6			CE
Butte LaRose Bay	Butte LaRose	49270	0.00		49-69		20.1	4.9 6/			CE
Bayou Moreau	Near Odenburg	40100	0.00		43-70		38.4				CE
Lateral Canal	Near Innis	40300	0.00		51-70		39.0	6/			CE
Bayou Latenache	Above Pointe Coupee Structure	40900	0.00		51-70		33.1	13.9			CE
Bayou Latenache	Below Pointe Coupee Structure	43500	0.00		51-70		31.1	13.9			CE
EABPL Borrow Pit (FWS) 5/	Dixie Bayou	49510	0.00		45-70			6/			CE
EABPL Borrow Pit (FWS) 5/	Ramah, above RR	49525	0.00		55-70			6/			CE
EABPL Borrow Pit (FWS) 5/	Ramah, below RR	49540	0.00		45-70			6/			CE
Upper Grand River (FWS) 5/	At Dike	49570	0.00		33-70		19.5	0.6			CE
EABPL Borrow Pit (FWS) 5/	Bayou Sorrel Lock	49630	0.00		49-70		14.5	0.0			CE
Intracoastal Waterway	Near Pierre Pass	49690	0.00		45-70		8.8	-0.9			CE
Bayou Teche	Calumet Floodgate (E)	64700	0.14		51-70		5.2	-2.2			CE
Lower Atchafalaya River	Berwick Lock (W)	03750	0.00		55-70		3.9	-2.0			CE
Wax Lake (E)	Control Structure	76480	0.00		55-70		2.2	-2.8			CE
Atchafalaya Bay	Eugene Island	88600	-2.99		39-70		9.8	-0.5			CE
East Cote Blanche Bay	Lukes Landing	88800	0.00		57-70		6.0	-3.7			CE
Bayou LaRompe	Lake Long	03210	7/								CE
Keelboat Pass	Lake Chicot	03615	7/								CE
Upper Grand River	Little Tensas Bayou	49440	7/								CE
EABPL Borrow Pit (FWS) 5/	Ramah	49540	7/								CE
Big Bayou Pigeon (FWS) 5/	Near Pigeon	49635	7/								CE
Old River (FWS) 5/	Jct. with G.I.W.W.	49645	7/								CE
Little Bayou Sorrel	Jct. with G.I.W.W.	49725	7/								CE
WABPL (FWS) 5/	Little Lake Long	49230	7/								CE
Bayou des Glaise (RS) 8/	Hamburgh	55900	7/								CE

5/ FWS - Floodway side.
6/ Intermittent gage record.
7/ New gages.
8/ From observed discharge.

present the maximum, minimum, 20 percent and 80 percent duration monthly flows for WRPA 9.

Peak flow frequency curves for each study station are shown in figures 373-376. These curves reflect the annual peak discharge for each station.

Low flow frequency curves for stations in WRPA 9 are shown in figures 377-380. These curves represent the lowest average flow for periods of 7, 15, 30, and 60 consecutive days. Low flow frequency curves are used in determining the dependable supply of surface water without storage in a stream.

Duration curves for daily flows are presented in figures 381-384. The curves indicate the percent of time that any given flow is equaled or exceeded at each site. The occurrence of these flows is not necessarily during consecutive periods, but the flows may have occurred at any time during the period of record for the station.

Tables 237-240 present data on the dependable yield characteristics at each of the selected discharge sites. These tables show the lowest mean flows for from 1 to 10 consecutive years of the period of record.

Flow Velocities

A time of travel study has been made on the Calcasieu River between Glenmora and Lake Charles, La. Travel times were measured with dye tracings through subreaches of the Calcasieu River for an intermediate flow condition. These data were used to compute the velocity of flow in each subreach, as shown in figure 52.

The velocities correspond to a specific discharge, and since velocity is a function of discharge, the user should be cautious in applying these data to any other conditions of flow. In general, stream velocities vary with discharge so that at higher discharges, greater velocities would be expected. The discharges shown in figure 52 for WRPA 9 are for flows which are equaled or exceeded about 60 percent of the time.

The velocities represent the average velocity through a subreach; however, velocities can vary from point to point within a subreach. The velocities given for WRPA 9 were based on preliminary studies and are subject to revision upon completion of more detailed studies.

River Profiles

Profiles of the major streams are shown in figures 385-389. The profiles were constructed from topographic maps and hydrographic surveys. The average annual high water stage was plotted from data for various gaging stations along the river.

HURRICANE OVERFLOW

Figure 390 outlines the areas which would be flooded by the occurrence of a hurricane with a once in 100-year return frequency and a Standard Project Hurricane (SPH). The SPH is defined as a synthetic hurricane which represents the most severe combination of hurricane parameters that is reasonably characteristic for a specified region, excluding extremely rare combinations. The frequency of recurrence for the SPH is dependent on the vulnerability of the location of interest to hurricanes on tracks critical to the area. It is considered to be such a rare event that the assignment of a frequency is inappropriate. Parameters for the SPH, from which hurricanes of other intensities may be derived, have been assigned by the U. S. National Weather Service and mutually agreed upon by representatives of that agency and the Corps of Engineers. The limits of flooding, as shown in figure 390, represent flooding which would be caused by many hurricanes whose tracks would be critical to all areas simultaneously. This was accomplished by transposing the tracks successively along the coast so that each segment of coast, in turn, would be subjected to maximum flooding from a hurricane of the same intensity.

Quality

Chemical analyses of samples collected from the Atchafalaya, Vermilion, and Calcasieu Rivers are representative of the dissolved constituents in water from streams draining WRPA 9. The dissolved-solids content ranged from 89 to 17,900 mg/l, hardness ranged from 32 to 3,190 mg/l, and pH ranged from 6.4 to 8.1 units. The higher concentrations of dissolved solids and hardness in surface water are the result of oil field waste or salt-water intrusion from the Gulf of Mexico. Generally, the quality of surface water is good; however, in and around municipal and industrial complexes the quality of water varies, depending upon the relative rates of streamflow and the release of wastes. Normally, the dissolved-solids content is low and the chemical characteristics are fairly uniform when the streams are low and most of the water is from the shallow ground water aquifers where the composition of the geologic units is the controlling factor.

The principal dissolved constituents in the Atchafalaya and Vermilion Rivers are bicarbonate, sulfate, calcium, and chloride. The chemical constituents and properties of water are shown in table 241.

Table 233 - Observed Mean Discharge in c.f.s., Sta 8-0155, Calcasieu River near Kinder, La., 1922-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1922												537	
1923	427	767	1,200	2,400	10,400	6,570	14,700	6,250	,2,330	1,560	1,450	2,410	4,150
1924	1,680	4,250	14,100	5,930	3,270	4,560	1,710	1,260	1,490	362	285	355	3,290
1925	315	324	430	6,210									
1939	381	700	893	5,649	3,388	2,549	812	1,037	672	708	999	338	1,505
1940	722	374	726	1,401	3,400	1,183	3,222	3,350	5,690	1,727	12,370	778	2,914
1941	509	6,675	11,430	4,223	2,317	2,948	1,261	6,294	8,510	7,325	1,787	1,392	4,575
1942	936	5,908	2,496	2,588	3,408	7,001	5,871	1,416	1,364	888	603	674	2,750
1943	420	391	780	1,479	1,628	2,751	1,770	569	403	716	474	1,505	1,070
1944	521	1,047	1,624	7,331	3,889	4,522	2,872	6,151	994	390	407	693	2,542
1945	514	1,062	2,586	6,422	5,250	4,417	7,530	3,066	1,777	3,021	1,064	652	3,100
1946	2,070	1,198	3,360	10,940	7,665	4,880	2,615	6,487	6,209	2,673	914	886	4,145
1947	1,150	3,371	2,851	11,370	2,106	5,713	5,839	1,838	3,056	515	346	381	3,221
1948	334	1,511	4,165	2,975	6,258	3,296	1,248	604	289	331	253	359	1,788
1949	285	3,392	4,178	4,844	6,421	7,332	13,210	2,762	763	1,499	985	537	3,822
1950	1,795	773	3,318	4,694	1,760	5,739	1,433	6,644	9,601	1,259	634	654	3,972
1951	498	652	691	3,914	3,172	1,612	2,728	1,047	383	370	265	680	1,322
1952	360	341	2,021	746	4,259	1,791	7,730	3,707	1,235	859	461	314	1,968
1953	263	332	1,184	1,611	4,707	5,155	1,539	36,390	980	1,195	787	458	4,565
1954	394	439	1,379	2,014	819	720	1,374	9,123	392	272	299	241	1,470
1955	348	298	308	1,387	9,521	1,237	4,680	4,067	534	1,850	6,684	932	2,609
1956	554	394	1,119	1,505	7,498	3,398	1,668	510	445	265	214	276	1,463
1957	235	409	5,649	1,225	1,619	5,664	3,993	2,095	1,332	1,728	470	642	2,098
1962	547	3,351	9,583	4,786	2,302	1,358	2,108	1,522	2,276	606	559	1,031	2,507
1963	381	532	2,107	4,019	2,620	1,963	578	378	464	855	433	353	1,220
1964	248	480	1,324	2,769	1,447	6,294	4,299	2,077	504	432	399	435	1,731
1965	378	396	4,364	1,509	3,357	4,893	1,502	610	505	327	297	403	1,540
1966	268	354	2,295	4,146	11,290	1,804	3,226	2,248	454	405	545	696	2,249
1967	1,186	3,121	1,684	1,818	2,731	1,329	5,985	2,899	1,101	644	410	313	1,921
1968	306	399	5,494	6,566	1,673	2,919	3,958	2,291	1,117	661	537	710	2,230
1969	385	472	4,226	1,469	4,048	5,087	5,693	3,831	731	811	387	321	2,279
1970	344	313	889	1,348	944	1,524	1,509	1,234	325	311	310	405	788
Mean	605	1,420	3,176	3,848	4,106	3,674	3,889	4,058	1,864	1,152	1,188	657	2,493

Table 234 - Observed Mean Discharge in c.f.s., Sta 8-0120, Bayou Nezpique near Basile, La., 1939-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1939	6	149	185	887	1,228	566	168	18	134	103	654	40	340
1940	245	257	148	92	1,137	272	2,438	1,323	2,459	1,066	5,169	83	1,285
1941	334	1,204	3,085	1,036	380	836	237	1,520	1,944	2,182	193	1,143	1,182
1942	452	1,329	2,026	1,338	708	1,892	667	186	919	466	76	313	866
1943	18	13	656	756	1,798	1,501	1,191	9	12	78	85	1,636	636
1944	57	570	830	3,072	1,061	2,121	590	1,242	89	11	54	355	841
1945	75	347	556	1,504	1,823	398	1,342	515	277	400	391	152	640
1946	585	107	1,469	3,652	1,417	702	12	1,977	1,148	2,419	757	266	1,217
1947	219	1,046	500	3,328	100	2,306	2,049	1,123	1,748	216	23	70	1,067
1948	6	835	1,519	1,099	2,294	1,439	131	15	0	92	43	69	623
1949	4	343	1,140	1,598	2,182	2,030	3,204	797	67	754	302	116	1,036
1950	841	43	535	1,027	2,609	1,814	77	1,137	1,912	277	195	97	870
1951	12	10	79	613	1,547	368	517	7	75	34	51	188	282
1952	30	20	453	40	1,054	266	2,228	1,250	51	233	81	73	477
1953	12	45	615	398	1,227	907	662	9,202	35	357	347	98	1,169
1954	30	87	469	870	94	168	219	1,737	17	114	75	18	330
1955	439	57	93	1,126	6,528	174	1,948	2,905	70	571	380	136	1,166
1956	10	77	327	131	2,228	1,015	215	36	32	26	54	56	343
1957	10	157	1,869	98	232	1,098	2,129	412	574	1,221	95	337	688
1958	838	2,982	1,150	1,099	1,199	958	715	298	184	348	843	1,264	985
1959	514	12	46	432	4,352	1,318	1,418	206	358	253	599	131	778
1960	83	704	1,566	1,227	1,253	329	100	470	51	86	429	108	533
1961	203	761	1,039	2,953	3,546	2,511	1,118	129	818	961	908	575	1,280
1962	17	1,174	1,275	1,620	431	124	611	202	1,500	73	172	576	646
1963	9	41	339	1,729	893	249	14	164	130	385	305	364	384
1964	9	157	708	1,615	578	2,246	1,709	765	37	289	404	678	769
1965	505	136	2,356	291	1,086	1,450	44	88	154	237	267	619	603
1966	17	82	990	1,647	2,933	359	1,317	1,401	96	158	141	161	762
1967	361	199	213	268	723	292	2,106	1,053	202	460	496	271	551
1968	105	350	2,250	1,703	89	988	872	387	134	189	175	318	635
1969	72	37	2,179	175	2,539	1,886	2,079	1,177	60	625	198	82	916
1970	25	60	497	214	243	588	528	1,050	58	222	120	244	323
Mean	192	418	974	1,176	1,547	1,036	1,020	1,025	480	466	440	332	757

Table 235 - Observed Mean Discharge in c.f.s., Sta 7-3855, Bayou Teche at Arnaudville, La., 1949-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1949								1,253	967	762	836	302	
1950	630	465	583	1,159	1,291	1,246	1,001	1,197	1,212	958	520	418	888
1951	318	378	623	1,018	1,153	951	1,011	570	226	358	304	351	602
1952	288	245	840	617	1,176	1,038	1,369	1,236	838	668	459	215	748
1953	138	186	954	981	1,211	1,396	1,078	2,921	1,839	896	712	422	1,062
1954	216	340	792	1,126	650	539	1,004	1,522	684	263	287	145	632
1955	559	278	270	993	1,775	959	1,312	1,031	708	924	977	601	860
1956	234	216	917	659	1,410	1,327	1,033	694	424	180	154	157	614
1957	112	244	807	592	716	1,088	1,215	1,034	1,067	1,157	695	648	782
1958	867	1,303	1,265	1,168	1,097	1,060	1,058	1,040	904	850	947	1,012	1,047
1959	912	381	419	769	1,380	1,111	1,101	892	970	727	684	529	819
1960	463	544	884	1,013	1,029	980	859	884	685	539	611	391	740
1961	343	708	833	1,413	1,215	1,608	1,442	1,115	1,179	1,199	864	1,000	1,075
1962	525	882	1,280	1,300	1,179	1,236	1,361	1,113	1,300	713	163	661	974
1963	447	322	672	1,247	1,217	1,036	903	492	315	532	288	195	639
1964	125	266	983	1,130	1,053	1,363	1,256	1,073	339	537	443	329	742
1965	858	727	1,345	1,064	1,126	1,396	1,109	1,002	543	234	225	644	855
1966	466	532	747	1,325	1,612	1,054	977	1,217	667	308	907	357	843
1967	701	674	658	758	887	861	1,394	1,375	982	974	579	757	882
1968	269	439	1,000	1,327	898	1,014	1,117	1,029	901	461	623	645	810
1969	439	366	1,110	840	1,087	1,300	1,275	1,143	598	488	709	279	802
1970	412	238	641	740	634	941	830	1,063	732	250	210	579	606
Mean	444	464	839	1,011	1,133	1,119	1,130	1,132	822	635	554	484	811

Table 236 - Observed Mean Discharge in 1,000 c.f.s., Sta 0304512, Atchafalaya River at Simmesport, La., 1928-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1928				148	129	145	192	245	196	270	139	70	
1929	46	62	120	121	182	206	323	351	377	202	68	38	175
1930	39	79	96	162	237	214	146	119	132	62	20	21	110
1931	26	23	46	42	42	82	108	90	55	33	35	31	51
1932	25	26	122	241	362	340	225	153	60	104	42	33	144
1933	28	34	59	183	213	213	258	309	290	72	70	44	148
1934	31	27	37	99	55	142	205	97	41	30	23	28	68
1935	30	29	80	105	196	215	316	326	344	308	100	55	175
1936	26	52	80	94	88	137	213	176	55	37	22	21	83
1937	55	71	57	182	391	381	200	225	152	97	60	55	160
1938	45	70	62	148	214	276	330	264	234	137	123	56	163
1939	55	43	52	87	217	345	348	304	140	115	58	34	150
1940	21	21	25	32	63	140	163	221	111	120	69	54	87
1941	27	39	98	121	113	99	133	163	138	103	45	48	94
1942	119	191	99	103	132	214	294	269	205	217	86	92	168
1943	74	86	111	241	167	165	290	267	389	196	84	54	177
1944	39	48	42	64	90	260	339	405	289	147	58	67	154
1945	59	48	78	206	145	393	591	544	386	325	127	72	248
1946	159	91	125	252	348	337	273	253	297	189	91	62	206
1947	55	138	146	218	213	132	250	325	287	245	70	53	178
1948	40	63	92	125	171	339	373	294	113	168	134	56	164
1949	45	85	175	288	457	452	401	251	212	167	102	76	226
1950	95	110	117	353	551	533	394	366	319	213	210	195	288
1951	140	103	201	236	329	401	380	336	226	322	198	138	251
1952	100	144	262	307	340	310	408	357	177	107	[illegible]	64	221
1953	44	43	86	95	172	273	281	349	264	130	[illegible]	52	156
1954	39	37	47	81	122	101	112	204	119	83	57	53	88
1955	66	76	60	132	132	271	355	194	143	105	76	49	138
1956	77	58	71	42	243	325	255	186	116	92	88	63	134
1957	48	46	80	108	297	241	301	365	431	309	134	86	204
1958	92	190	309	265	230	224	296	436	297	280	308	136	255
1959	127	88	110	104	263	278	242	191	169	96	103	71	154
1960	147	110	161	249	246	244	298	256	207	184	94	79	190
1961	71	81	108	130	118	366	442	417	354	168	152	115	210
1962	129	158	275	277	343	417	492	321	198	127	100	94	244
1963	109	103	103	114	102	245	323	149	126	73	60	40	129
1964	27	27	40	53	79	249	330	122	33	39	42	46	90
1965	64	50	152	182	239	301	394	307	182	126	81	112	182
1966	158	83	83	145	137	135	159	363	200	85	69	58	140
1967	55	65	118	119	119	196	237	298	256	216	121	80	157
1968	76	118	200	289	286	206	391	312	355	183	131	87	220
1969	86	100	214	221	394	298	353	372	218	241	158	94	229
1970	113	119	130	219	209	284	321	427	286	139	106	89	204
Mean	72	80	113	162	213	259	296	278	213	155	95	68	167

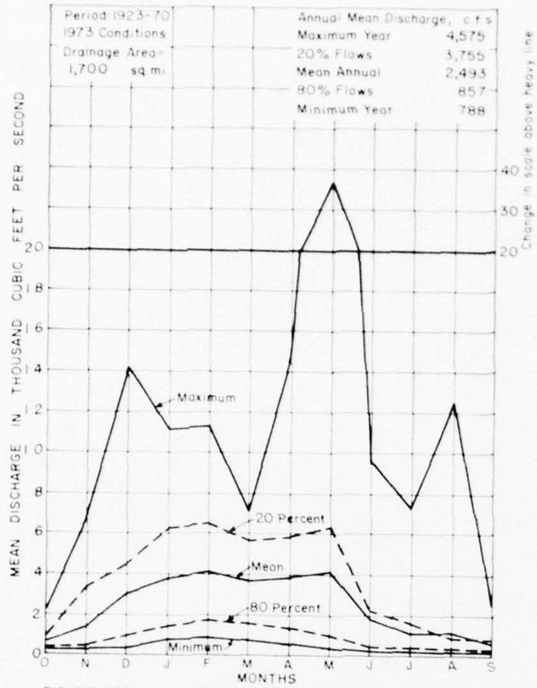


FIGURE 369 MONTHLY DISCHARGE
8-0155 CALCASIEU RIVER NEAR KINDER, LA.

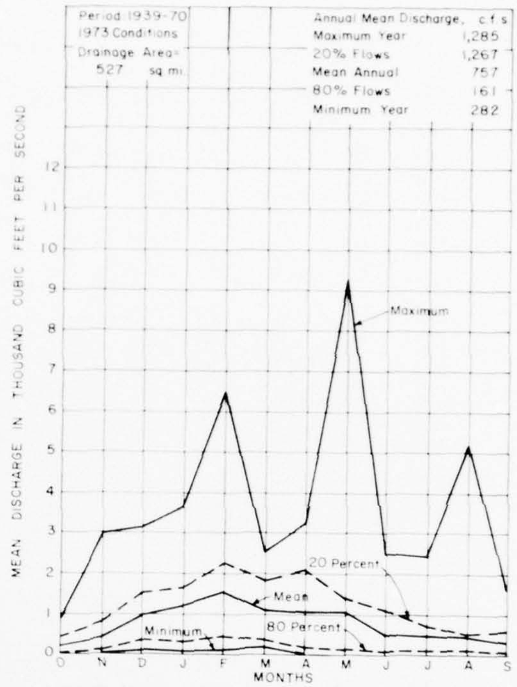


FIGURE 370 MONTHLY DISCHARGE
8-0120 BAYOU NEZPIQUE NEAR BASILE, LA.

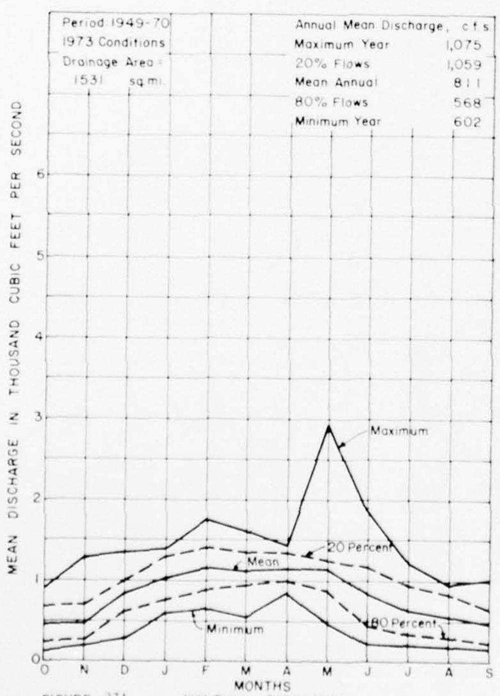


FIGURE 371 MONTHLY DISCHARGE
7-3855 BAYOU TECHE AT ARNAUDVILLE, LA.

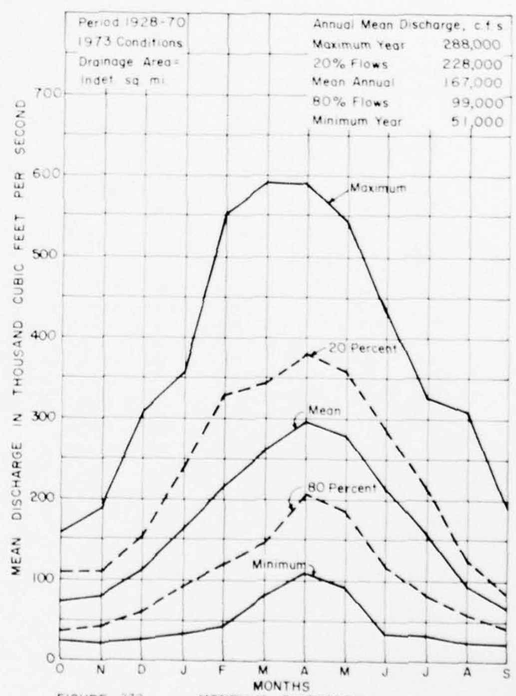


FIGURE 372 MONTHLY DISCHARGE
7-3815 ATCHAFALAYA RIVER AT SIMMESPORT, LA.

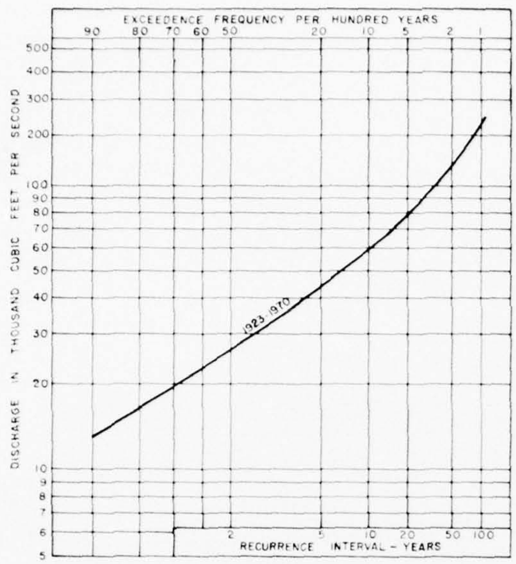


FIGURE 373 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
8-0155 CALCASIEU RIVER NEAR KINDER, LA.

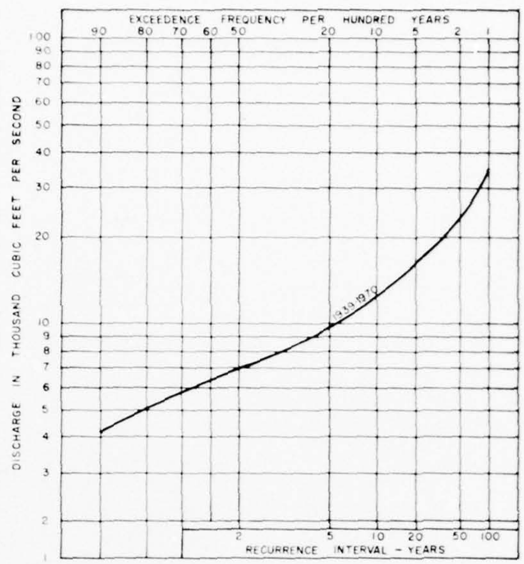


FIGURE 374 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
8-0120 BAYOU NEZPIQUE NEAR BASILE, LA.

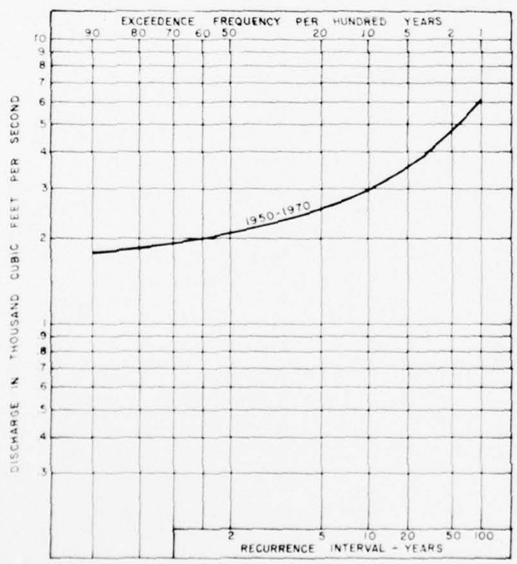


FIGURE 375 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3855 BAYOU TECHE AT ARNAUDVILLE, LA.

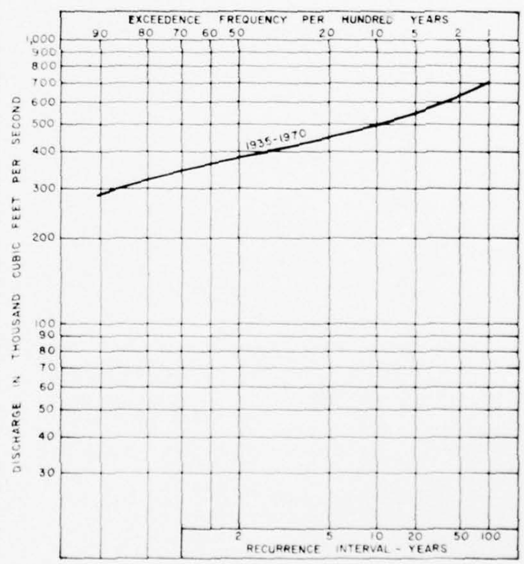


FIGURE 376 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3815 ATCHAFALAYA RIVER AT KROTZ SPRINGS, LA.
Note: SIMMESPORT, LA. DISCHARGE USED FROM 1965 to 1970

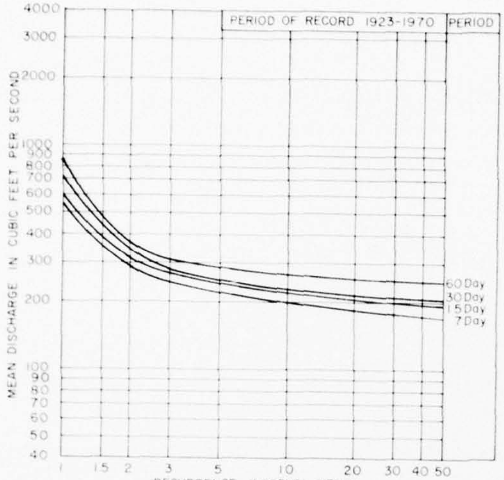


FIGURE 377 LOW FLOW FREQUENCY CURVES
8-0155 CALCASIEU RIVER NEAR KINDER, LA

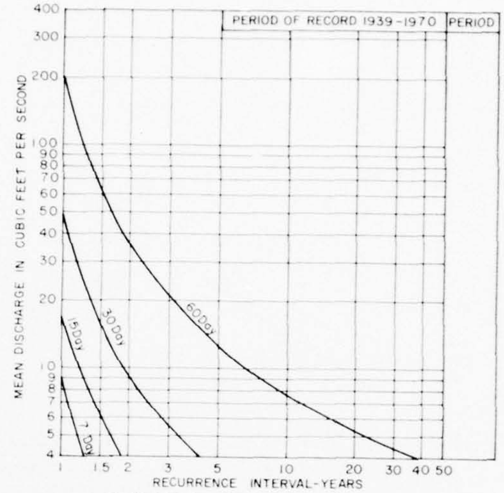


FIGURE 378 LOW FLOW FREQUENCY CURVES
8-0120 BAYOU NEZPIQUE NEAR BASILE, LA

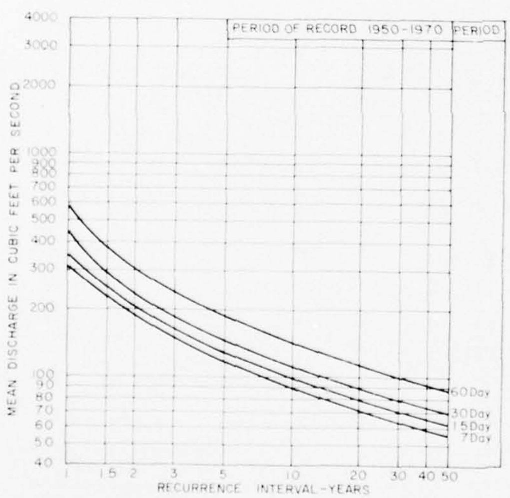


FIGURE 379 LOW FLOW FREQUENCY CURVES
7-3855 BAYOU TECHE AT ARNAUDVILLE, LA

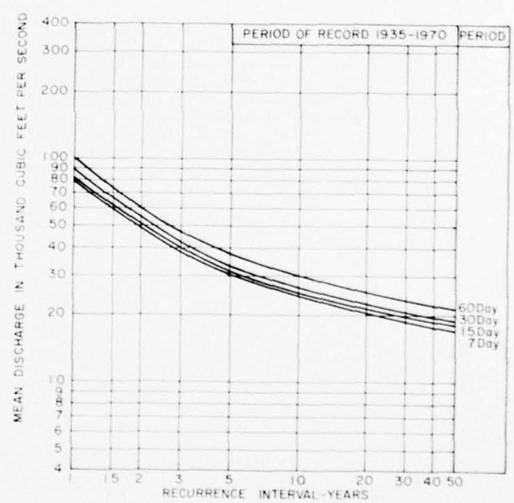


FIGURE 380 LOW FLOW FREQUENCY CURVES
7-3855 ATCHAFALAYA RIVER AT KROTZ SPRINGS, LA
Note: SIMMESPORT, LA. DISCHARGE USED FROM 1965 to 1970

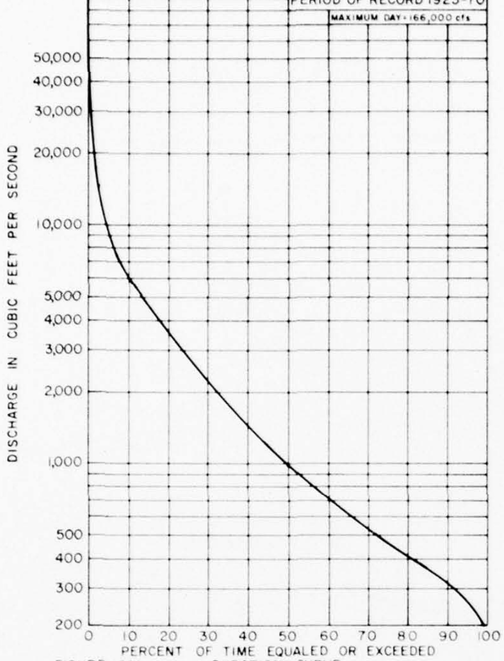


FIGURE 381 DURATION CURVE
8-0155 CALCASIEU RIVER NEAR KINDER, LA.

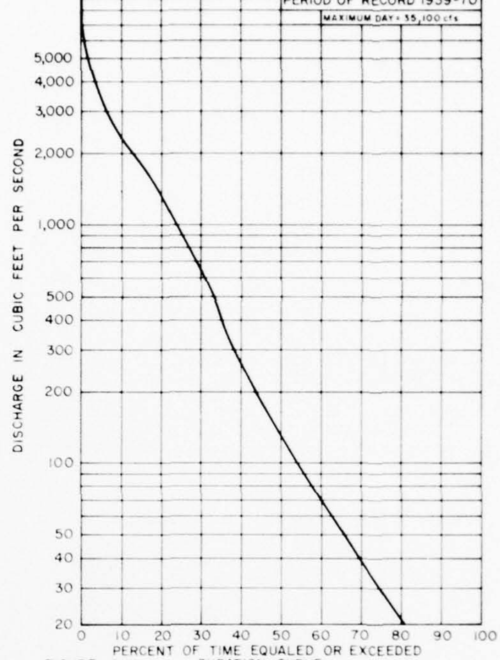


FIGURE 382 DURATION CURVE
8-0120 BAYOU NEZPIQUE NEAR BASILE, LA.

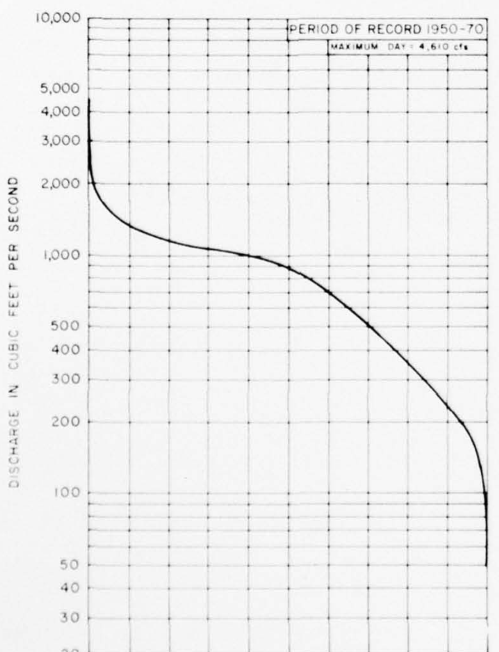


FIGURE 383 DURATION CURVE
7-3855 BAYOU TECHE AT ARNAUDVILLE, LA.

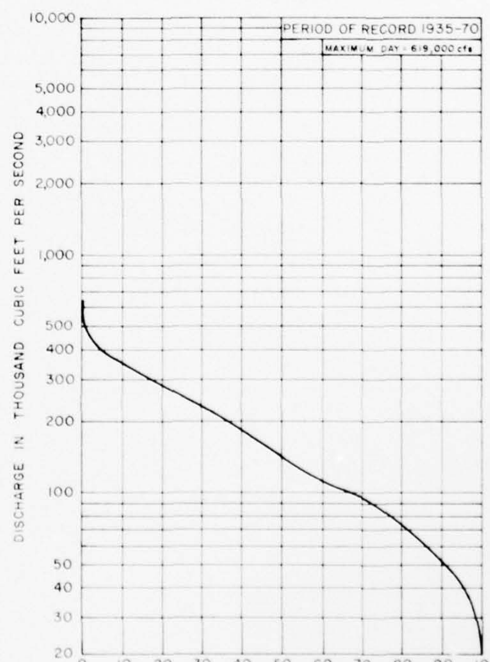


FIGURE 384 DURATION CURVE
7-3815 ATCHAFALAYA RIVER AT KROTZ SPRINGS, LA.
Note: SIMMESPORT, LA. DISCHARGE USED FROM 1965-1970

Table 237 - Dependable Yield at Sta 8-0155, Calcasieu River near Kinder, La.

Consecutive Years 1/ of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1923-1970 Mean
1	1970-1970	788	31.6
2	1943-1944	1,306	52.4
3	1963-1965	1,497	60.0
4	1963-1966	1,685	67.6
5	1962-1967	1,732	69.5
6	1963-1968	1,815	72.8
7	1964-1970	1,819	73.0
8	1963-1970	1,745	70.0
9	1962-1970	1,829	73.4
10	1948-1957	2,508	100.6
30	1923-1970	2,493	100.0

1/ 1922-24, 1938-57, 1961-70.

Table 238 - Dependable Yield at Sta 7-3855, Bayou Teche at Arnaudville, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1950-1970 Mean
1	1951-1951	602	74.2
2	1951-1952	675	83.2
3	1954-1956	702	86.6
4	1954-1957	722	89.0
5	1951-1955	781	96.3
6	1951-1956	753	92.8
7	1951-1957	757	93.3
8	1950-1957	773	95.3
9	1962-1970	795	98.0
10	1951-1960	791	97.5
21	1950-1970	811	100.0

Table 239 - Dependable Yield at Sta 8-0120, Bayou Nezpique near Basile, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1939-1970 Mean
1	1951-1951	282	37.2
2	1951-1952	379	50.1
3	1950-1952	543	71.7
4	1962-1965	606	80.0
5	1963-1967	614	81.1
6	1963-1968	617	81.5
7	1961-1968	621	82.0
8	1963-1970	618	81.6
9	1962-1970	621	82.0
10	1961-1970	687	90.7
17	1939-1970	757	100.0

Table 240 - Dependable Yield at Sta 0304512, Atchafalaya River at Simmesport, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1929-1970 Mean
1	1931-1931	51,000	30.5
2	1930-1931	80,000	47.9
3	1930-1932	102,000	61.1
4	1931-1934	103,000	61.7
5	1930-1934	104,000	62.3
6	1931-1936	112,000	67.1
7	1930-1936	111,000	66.5
8	1929-1936	119,000	71.2
9	1929-1937	122,000	73.0
10	1931-1940	123,000	73.6
22	1929-1970	167,000	100.0

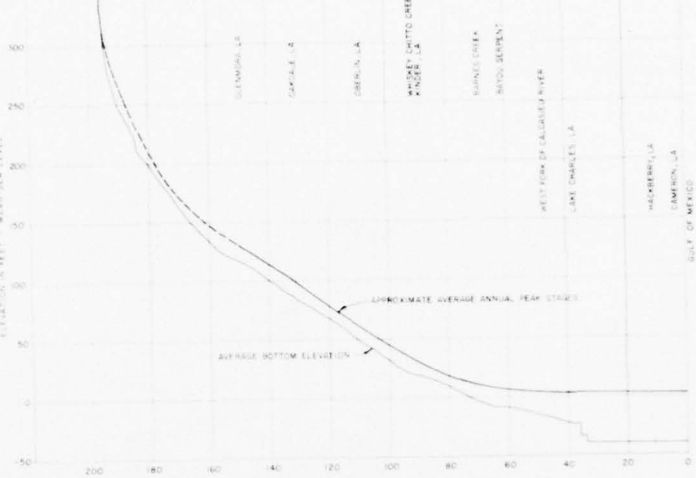
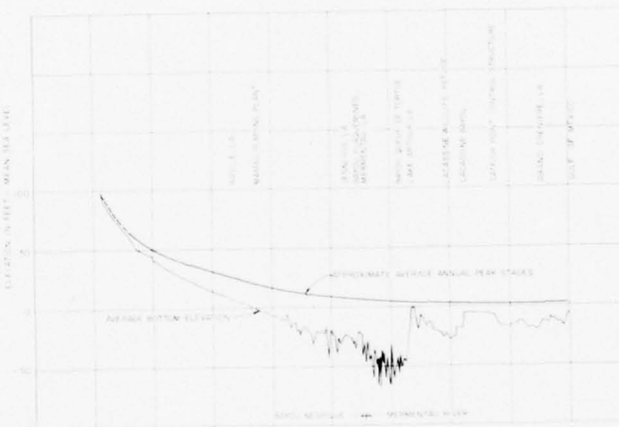
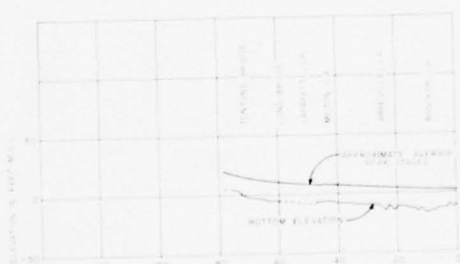


FIGURE [illegible] STREAM PROFILE, CALCASIEU RIVER, LA



DISTANCE IN MILES ABOVE MOUTH OF MERMENTAU RIVER
FIGURE [illegible] STREAM PROFILE, MERMENTAU RIVER, LA



DISTANCE IN MILES ABOVE MOUTH OF VERMILION RIVER
FIGURE [illegible] STREAM PROFILE, VERMILION RIVER, LA

DISTANCE IN MILES ABOVE MOUTH OF BAYOU TECHE
FIGURE [illegible] STREAM PROFILE, BAYOU TECHE, LA

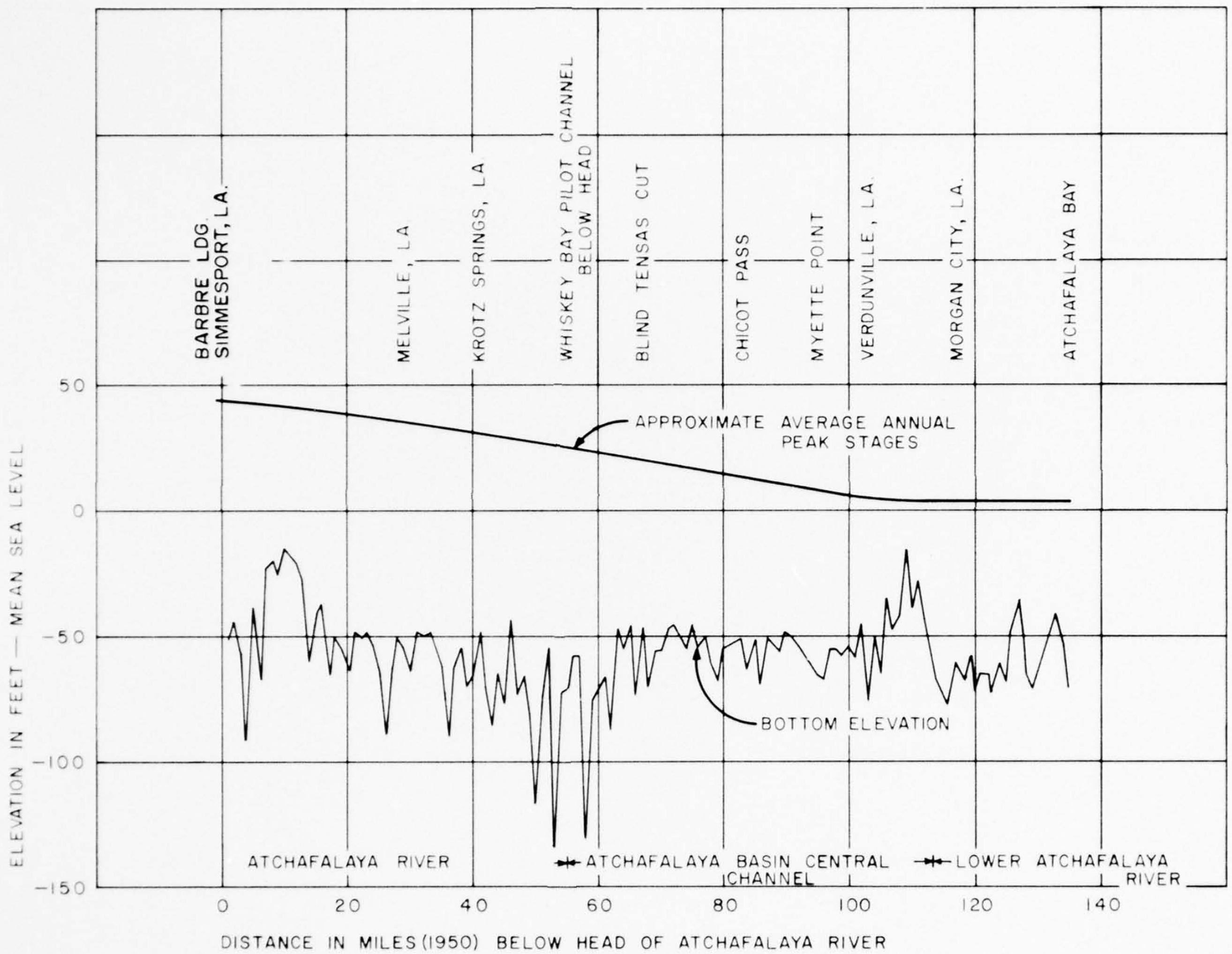


FIGURE 389 STREAM PROFILE, ATCHAFALAYA RIVER, LA.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

LIMITS OF HURRICANE OVERFLOW

WRPA 9

FIGURE 390

Table 241 - Chemical Analyses of Surface Waters in WRPA 9 in the Lower Mississippi Region, Milligrams Per Liter

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Color
															Calcium, magnesium	Non-carbonate			
	07381500 Atchafalaya River at Krotz Springs, La.																		
	10-13-70	--	7.2	0.02	35	9.4	17	3.6	116	39	20	0.2	2.5	195	130	31	339	7.0	10
	11-10-70	--	7.0	.03	45	11	24	3.6	128	56	25	.2	4.4	251	150	44	414	7.5	15
	12- 3-70	--	7.6	.02	42	12	21	3.3	128	58	24	.2	3.6	247	150	49	410	7.2	10
	1- 6-71	--	7.6	.04	37	7.7	17	3.4	97	44	25	.1	4.1	203	120	44	336	7.2	20
	2- 4-71	--	7.3	.10	37	9.4	15	1.8	115	42	18	.1	2.5	206	130	37	333	7.2	20
	3- 5-71	--	7.2	.02	33	5.2	17	2.6	92	38	19	.1	3.5	198	100	29	294	7.1	40
	4- 6-71	--	7.2	.01	37	7.9	14	3.1	108	41	18	.1	5.2	199	120	36	332	8.1	15
	5- 6-71	--	9.1	.01	42	11	18	2.6	138	45	21	.2	2.0	242	150	39	396	7.2	10
	6- 2-71	--	12	.06	33	8.2	16	3.0	96	47	17	.2	2.8	207	120	37	317	7.7	20
	7-12-71	--	4.1	.01	48	13	26	3.1	163	50	26	.2	.9	272	170	38	454	7.0	20
	8-12-71	--	5.7	.02	35	10	23	2.8	120	43	26	.2	1.2	216	130	32	376	7.3	10
	9- 8-71	--	2.7	--	40	12	30	2.8	140	51	31	.3	.4	249	150	35	442	7.4	10
Quaternary	07386935 Vermilion River at State Highway 3073, near Lafayette, La.																		
	10- 2-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	274	--	--
	10-16-70	--	7.8	0.15	11	2.6	10	6.0	44	8.0	14	0.1	0.5	106	38	2	143	--	--
	10-30-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	153	--	--
	11-13-70	--	12	.15	15	3.8	23	4.0	68	10	27	.3	1.3	140	53	0	219	7.8	70
	11-27-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	245	--	--
	12-11-70	--	16	.10	20	5.6	43	6.0	103	12	51	.2	.3	220	73	0	359	7.2	50
	1-12-71	--	12	--	15	5.2	29	3.8	55	27	33	.1	3.3	188	59	14	268	7.1	90
	1-22-71	--	12	.18	16	9.5	33	3.3	70	11	56	.2	2.6	208	79	22	323	6.5	35
	2- 5-71	--	12	.13	21	8.1	56	4.8	128	14	64	.2	4.1	280	86	0	446	6.8	50
	2-19-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	181	--	--
	3- 8-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	191	--	--
	3-19-71	--	7.0	.18	11	3.8	21	3.4	47	8.2	32	.1	2.5	143	43	4	205	6.8	55
	4-19-71	--	--	--	--	--	--	3.0	81	9.2	22	.1	2.6	149	69	3	226	6.9	45
	5-13-71	--	7.8	.07	11	3.0	11	3.5	47	7.4	14	.1	.4	99	40	1	142	6.5	100
	5-27-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	154	--	--
	6-10-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	185	--	--
	6-25-71	--	15	.07	26	7.1	74	3.2	112	18	108	.2	.3	312	94	2	571	6.4	20
	7-27-71	--	9.7	.12	15	4.8	20	4.0	63	8.2	28	.1	2.8	149	57	5	222	7.2	60
	8-13-71	--	10	.27	15	4.0	10	3.6	69	2.2	13	.1	.7	125	54	0	166	7.0	70
	8-23-71	--	16	.35	19	6.2	22	3.6	89	7.2	28	.1	3.1	175	73	0	266	7.1	50
	9-20-71	--	5.8	.02	8.7	2.5	10	5.0	40	4.6	16	.1	.7	89	32	0	130	6.6	70

Table 241 - Chemical Analyses of Surface Waters in WRPA 9 in the Lower Mississippi Region, Milligrams Per Liter--Continued

Geologic units in drainage basin above sampling station	Date sampled	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
08017090 Calcasieu River near Sulphur, La.																			
Quaternary--Continued	10-20-70	--	2.7	0.08	100	204	--	--	41	148	3,100	0.3	--	--	1,090	1,060	9,840	6.9	30
	12- 2-70	--	5.1	.01	--	--	4,050	200	82	952	6,960	.7	--	13,500	2,320	--	20,000	7.1	20
	12-16-70	--	4.2	.07	--	--	4,550	310	96	1,090	7,600	.8	--	14,800	2,600	--	22,200	7.3	15
	1-22-71	--	5.4	.03	158	354	--	--	71	338	5,140	.3	--	10,300	1,850	1,790	16,200	6.8	15
	2-23-71	--	5.9	.07	42	58	550	23	32	130	912	.2	--	1,890	340	316	3,450	6.6	80
	3-17-71	--	6.6	.06	70	101	840	--	36	240	1,520	.2	--	3,060	590	560	5,380	6.7	60
	4- 7-71	--	10	--	60	107	1,000	38	58	244	1,700	.4	--	6,870	590	542	11,000	7.1	40
	5-19-71	--	5.5	.04	86	27	480	24	34	110	850	.2	0.5	1,800	320	300	3,060	6.4	30
	6-16-71	--	6.6	.03	188	320	2,590	80	81	84	5,220	.6	--	10,400	1,790	1,720	16,000	7.4	30
	7-28-71	--	9.7	.02	285	602	--	150	102	132	9,200	.8	--	17,900	3,190	3,110	26,500	7.5	30
	8-17-71	--	7.6	.01	198	499	--	--	88	117	7,630	.7	--	15,000	2,550	2,480	22,400	7.9	5
	9-22-71	--	9.9	.03	164	357	3,170	120	83	682	5,400	1.0	--	10,500	1,880	1,810	15,500	7.5	40

GROUND WATER

Except for a few coastal areas, fresh ground water is available throughout WRPA 9 (figure 391). Water bearing Quaternary deposits blanket nearly all of the area, and underlying Tertiary aquifers yield fresh water in most of the northern half. The Tertiary deposits dip southward and contain fresh water to depths of more than 3,000 feet.

Most of the 950 mgd of ground water pumped in WRPA 9 is for irrigation and industrial uses. The Chicot-Atchafalaya aquifer of Quaternary age supplies almost 99 percent of the total withdrawn. Only about 12 mgd is pumped from the Tertiary aquifers, which are composed of Miocene and Pliocene sands.

Tertiary Aquifers

The Tertiary deposits that underlie WRPA 9 are covered by Quaternary alluvium except for part of Vernon Parish, where Miocene deposits are exposed at the surface. The Miocene beds dip and thicken southward and are in turn overlain by Pliocene strata. The Miocene and Pliocene sediments are virtually identical lithologically as far as properties that affect hydrology are concerned. The sands that form the aquifers in these deposits are interbedded with clays and are considered a hydrologic unit, the Mio-Pliocene aquifer for purposes of this report. Although these deposits are many thousands of feet thick, they do not contain fresh water much deeper than 3,000 feet below mean sea level in the area.

Massive sands occur locally, but most individual sand beds are less than 100 feet thick and are fine to medium grained. Because sand thickness varies considerably and the sand beds are discontinuous and occur somewhat at random throughout, transmissibility values for aggregate sand thickness are not meaningful. Permeabilities are in the 250-1,000 gpd per square foot range, and high well yields are obtainable. Although most wells completed in these aquifers yield less than 1,000 gpm, yields as high as 4,000 gpm have been obtained by screening all or nearly all available sands.

Water in the Mio-Pliocene aquifer is a soft sodium bicarbonate type where it is fresh. It is generally low in iron content and may be corrosive. In the northern part of the area, the quality may be affected locally by water movement from overlying deposits. Downdip the water becomes salty. A so-called "ridge" of salty water occurs in the northeastern part of the area where sands beneath the Quaternary deposits do not contain fresh water. East and west of this "ridge" the Miocene and Pliocene sands contain fresh water at rapidly increasing depths.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

GEOLOGIC SOURCES OF GROUND WATER

WRPA 9

FIGURE 391

AD-A041 351 LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY COORDINA--ETC F/G 8/6
LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY. APPENDIX C, VOLUM--ETC(U)
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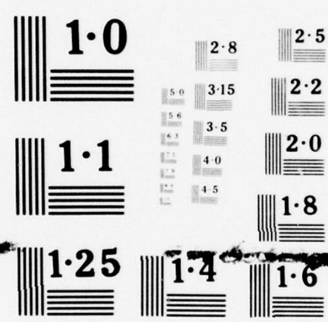


NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

Withdrawals from the Tertiary aquifers are small (about 25 mgd) considering the large areas in which they contain fresh water and are capable of sustaining high-yield wells. Only a relatively few wells are screened in these sands, and these wells are mainly for industrial, municipal, and rural domestic uses. Most of the water pumped is for industrial usage in the vicinity of Alexandria, La. Because of the limited use of these aquifers, water levels are still high, and the potential for future development of supplies that need little or no treatment is quite good.

Quaternary Aquifers

Chicot-Atchafalaya Aquifer

The Chicot-Atchafalaya aquifer system functions as a hydrologic unit and is treated as such in this report, although both aquifers are not present over the entire area. The Atchafalaya aquifer is composed of those sandy and graveliferous deposits that underlie the Atchafalaya River floodplain. The Pleistocene sands of the Chicot aquifer are both adjacent to and directly beneath the Atchafalaya aquifer and are in direct hydraulic connection. The thickness of these deposits increases southward to several thousand feet. However, at the southern limit of fresh water, roughly along the margin of the Gulf of Mexico, the sands contain salty water below depths ranging from about 100 to more than 700 feet. The maximum depth of fresh water in these sand beds is about 1,000 feet in the east-central part of the area.

The Chicot aquifer is the most extensive and heavily used part of the system. The individual sand beds generally grade coarser downward and have an average coefficient of permeability of about 1,500 gpd per square foot. The varying thickness of sands causes a wide range in known coefficients of transmissibility for individual sands, from less than 100,000 to about 1,000,000 gpd per foot. The transmissibility of the aggregate sand thickness is estimated to be greater than 1,500,000 where the thickness of fresh water bearing sands is greatest. Although larger yields are possible, most large wells tapping the Chicot aquifer yield 3,000 to 4,000 gpm.

Fresh water in the Chicot-Atchafalaya aquifer systems is a hard, calcium magnesium bicarbonate type. It is characteristically high in iron content. Local variations occur, generally in the northern part of the area, where the quality of the water is influenced by water moving into the Chicot-Atchafalaya aquifer from underlying Pliocene sands.

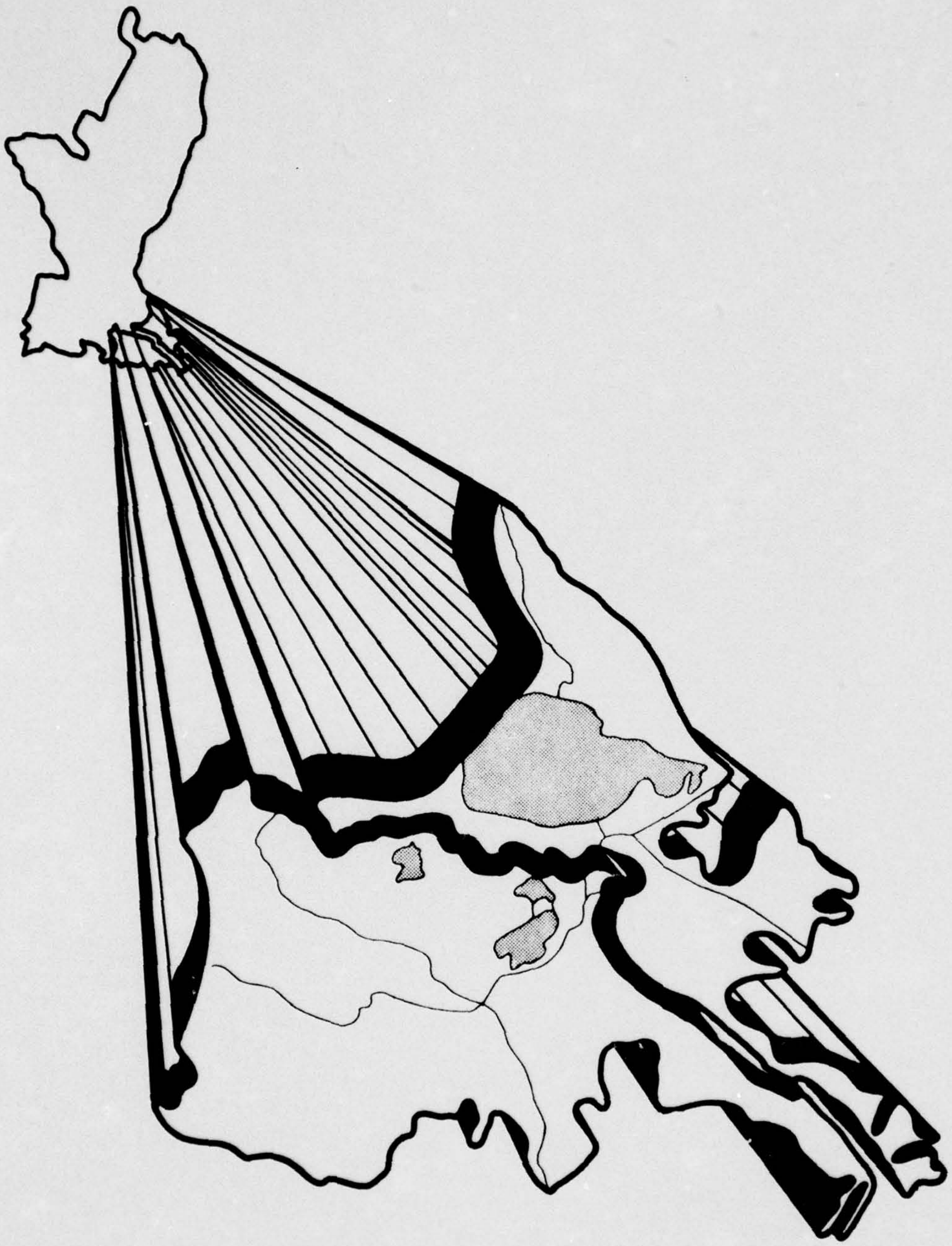
Withdrawals from the Chicot-Atchafalaya aquifer in WRPA 9 are very great (about 940 mgd), and widespread water level declines have resulted. The heavy withdrawals are primarily by large industries in the Lake Charles area and by rice irrigation wells; about three-fourths of the total is for irrigation. Although pumpage from the aquifer is great,

most of it is seasonal; and the potential for further development of large supplies is good when considered on a regional basis.

Effects of Ground Water Withdrawals and Management Considerations

The small withdrawals from the Miocene and Pliocene aquifers have not seriously affected water levels. Additional large supplies of water that require little or no treatment can be developed. The potential for salt-water encroachment exists in the vicinity of interfaces. Careful planning of the locations of future pumping centers can minimize or prevent this danger.

The large cone of depression in the piezometric surface of the Chicot-Atchafalaya aquifer and the continuing water level declines (slightly more than one foot per year) are almost entirely the result of continuous pumping, mainly for industrial uses. Seasonal water level recovery from irrigation pumpage is virtually complete. In addition, water levels have shown no tendency to progress to the recharge area and have not declined at all in the eastern part of the area where the Atchafalaya aquifer can support greatly increased withdrawals, especially if planners are able to take advantage of areas where recharge conditions are particularly favorable. The threat of salt-water encroachment exists in much of the area and has already begun south of Lake Charles; however, encroachment is not a danger in many places where large supplies are available.



WRPA 10

W R P A 10

INTRODUCTION

WRPA 10, an area covering 7,729 square miles and representing approximately 8 percent of the Lower Mississippi Region, lies in southeastern Louisiana. About 5,920 square miles of the area are land and the remaining 1,809 square miles are water. The area is bounded on the west by the East Atchafalaya Basin protection levee and Bayou Tigre drainage area, on the north by the Amite, Tickfaw, Natalbany, Tangipahoa, and Pearl River Basins, on the east by the Mississippi, Chandeleur, and Breton Sounds, and on the south by the Gulf of Mexico. The Mississippi River (WRPA 1) divides WRPA 10 into two areas; approximately one-third of the area is north of the Mississippi River and the remaining two-thirds is south of the river. Most of WRPA 10 is influenced by tides due to its proximity to the Gulf of Mexico. Major hurricanes may raise the Gulf as much as 12 feet above m.s.l., 1/, and, during the winter, strong northerly winds depress the water surface as much as 2 feet below m.s.l.

The area south of Lake Pontchartrain was formed by seven major Mississippi River Delta complexes. From oldest to youngest, the delta complexes are: Sale, Cypremort, Cocodrie, Teche, St. Bernard, Lafourche, Plaquemine, and the present, Balize. This area is composed of complex intertwining tidal channels and irregular water bodies. The major waterways are: Gulf Intracoastal Waterway (GIWW), a 12- by 150-foot navigation channel from Lake Borgne to the Inner Harbor Navigation Canal in New Orleans, and a 12- by 125-foot channel to the Sabine River; Barataria Bay Waterway, a 12- by 125-foot navigation channel from mile 15.0 of the GIWW to the Gulf of Mexico, a distance of about 35.5 miles; Mississippi River Gulf Outlet, a 36- by 500-foot ship channel extending approximately 76.0 miles in a land and water cut from the junction of the Inner Harbor Navigation Canal and the GIWW in New Orleans, La., to the 38-foot contour in the Gulf; Bayou Lafourche and Lafourche-Jump Waterway, a 6- by 60-foot channel from Napoleonville to Golden Meadow, La., and a 12- by 125-foot channel from Leeville, La., to the Gulf, a distance of about 108 miles, and Houma Navigation Canal, a 15- by 150-foot canal from the GIWW near the western edge of Houma, La., to the Gulf of Mexico.

North of Lake Pontchartrain, WRPA 10 consists only of the Tchefuncta River Basin. The Tchefuncta River has its source in northeast Tangipahoa Parish and flows southward for about 50 miles to discharge

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1/ Mean sea level - the datum to which all elevations are referenced unless otherwise noted.

into Lake Pontchartrain. The Tchefuncta River has a project channel of 10 by 125 feet from the 10-foot depth in Lake Pontchartrain to mile 3.5, and 8-foot depth over an unspecified bottom width from mile 3.5 to about mile 10.7.

SURFACE WATER

Quantity

The average annual discharge of all streams originating in WRPA 10 is about 11,400 c.f.s., or about 1.5 c.f.s. per square mile; however, about 50 percent of this flow originates in the salt to brackish marshes bordering on the Gulf of Mexico.

Present Utilization

The total withdrawals of water from the surface water sources of WRPA 10 were greater than those from any other WRPA in the Lower Mississippi Region during 1970. Withdrawals from fresh surface water sources in the area averaged about 8,210 c.f.s., or about 94 percent of the total surface water withdrawals, with most of the water being withdrawn from the Mississippi River. The remaining 6 percent, or 555 c.f.s., was withdrawn from brackish water sources and used mainly by mineral industries (284 c.f.s.) and for power production (224 c.f.s.). The major uses of fresh water were for industrial purposes (3,080 c.f.s.), fish and wildlife enhancement (2,850 c.f.s.), and power production (1940 c.f.s.).

Ground water withdrawals from WRPA 10 during 1970 averaged about 110 c.f.s. Major uses were for industrial purposes (41 c.f.s.) and power production (33 c.f.s.).

WRPA 10 was also the leading consumer of water in the Lower Mississippi Region during 1970. About 3,420 c.f.s., or 39 percent of the total surface and ground water withdrawals from the area, was consumed. The remaining withdrawals of 5,455 c.f.s. were released and returned to streamflow. This resulted in a net decrease to the area's streamflow of about 3,310 c.f.s. Major consumptions of water were for fish and wildlife enhancement (2,860 c.f.s.) and industrial purposes (170 c.f.s.). Recreation was a popular nonconsumptive use of water, with most lakes and streams used for fishing, boating, and other water sports.

Table 15 of the Regional Summary presents additional data on the present withdrawals and utilization of water in WRPA 10 during 1970.

Stream Management

The major purposes for management of streamflow in WRPA 10 are industrial, fish and wildlife, and flood control. In the tributary basin, emphasis is almost entirely on industrial and fish and wildlife.

Impoundments. In WRPA 10, there are no reservoirs which have a total capacity of 5,000 acre-feet or more.

Diversions. A pumping plant at Donaldsonville, La., pumps the total

flow of Bayou Lafourche from the Mississippi River except for small amounts of storm drainage during freshets; the remaining diversions are made for industrial, fish and wildlife, and municipal uses.

Channel modification. Channel modification, which consisted of channel enlargement, has taken place on the two major streams, Bayou Lafourche and Tchefuncta River, in WRPA 10.

Navigation. One of the most important uses of water in WRPA 10 is for navigational purposes. Deepwater navigation is provided on the Mississippi River-Gulf Outlet, a man-made channel from Chandeleur Sound to New Orleans, La.; inland navigation is provided on Bayou Lafourche, Tchefuncta River, Gulf Intracoastal Waterway, and several other navigation canals.

Streamflow

In this study, the various periods of flow that were used for the selected gaging stations were determined based on the availability of discharge data at the sites.

Measurement facilities. Streamflow data at two sites in WRPA 10 were selected for presentation in this section. Because of tidal influences, daily discharge records are available only for the headwater areas of the principal streams; however, daily stage records are available from stations located within the areas of tidal influence. The locations of these sites are shown in figure 392 and are identified by U. S. Geological Survey and Corps of Engineers station numbers. A summary of the controlling agency, drainage area (where available), period of record, gage datum, and other pertinent data for each of these stations is shown in table 242.

Average discharge for WRPA 10. Figure 392 also presents isopleths showing the mean annual runoff for the northern part of WRPA 10. (Mean annual runoff for the southern part is not available because of tidal influence.) Streams originating in WRPA 10 have an estimated average annual discharge of about 11,400 c.f.s.

Average discharge for selected stations. Observed mean discharges by months for selected gaging stations are given in tables 243 and 244.

Figures 393 and 394 are graphical representations of the average monthly discharge for selected discharge sites. The figures also present the maximum, minimum, 20 percent and 80 percent duration monthly flows for WRPA 10.

Peak flow frequency curves for each study station are shown in figures 395 and 396. These curves reflect the annual peak discharge for each station.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

MEAN ANNUAL RUNOFF IN INCHES

WRPA 10

FIGURE 392

Table 242 - Streamflow Data for Water Resources Planning Area 10

Stream	Station	Station No.	Gage Datum (feet)	Drainage Area (square miles)	Period of Record	Mean (c.f.s.)	Gage Readings (feet) Maximum	Gage Readings (feet) Minimum	Momentary Flow (c.f.s.) Maximum	Momentary Flow (c.f.s.) Minimum	Agency
Inner Harbor Navigation Canal	New Orleans (IWW) 1/	76160	-32.19		22-70		42.8 2/	29.9			CE
Inner Harbor Navigation Canal	Florida Ave. Bridge (IWW) 1/	76120	-20.55		44-70		30.4	19.5			CE
Intracoastal Waterway	Near Paris Road Bridge	76040	-0.78		44-70		10.8	-1.4			CE
Inner Harbor Navigation Canal	Near Seabrook Bridge	76060	-0.78		42-60 62-70		7.2	-0.8 3/			CE
Lake Pontchartrain	West End	85625	-10.00		31-46 49-70		17.6	7.8			CE
Lake Pontchartrain	Little Woods	85650	-10.00		31-70		17.0	7.8			CE
Lake Pontchartrain	Near South Shore	85675	-10.00		49-70		17.2	8.7			CE
Rigolets	Near Lake Pontchartrain	85700	-10.00		31-70		19.0	8.1			CE
Lake Borgne	Rigolets	85725	-10.00		57-70		22.2 2/	8.0			CE
Chef Menteur Pass	Near Lake Borgne	85750	-10.00		45-50 57-70		19.1	8.5 3/			CE
Bayou Vincent	Slidell	85535	0.00		62-70		7.4	-0.3			CE
Bayou Bonfouca	Slidell	85540	0.00		62-70		6.8	-0.6			CE
Bayou Liberty	Near Slidell	85545	0.00		62-70		6.0 4/	-0.6			CE
Lake Pontchartrain	Frenier	85550	-10.00		31-65 69-70		22.1 2/	7.9			CE
Lake Pontchartrain	Mandeville	85575	-10.00		31-70		17.0	7.8			CE
Lake Pontchartrain	Midlake near New Orleans	85600	-10.00		57-70		15.5	8.7			CE
Bayou Petit Caillou	Cocodrie	76305	0.16		69-70		3.3	-0.9			CE
Tchefuncta River	Near Folsom	7-3750	62.1	95.5	43-70	153	22.3	4.8	29,200	26	USGS
Bayou LaFourche	Thibodaux	7-3810	0.00		66-70		6.7	0.8			USGS
Bayou LaFourche	Valentine	7-3812	0.00		66-70		2.1	-0.2			USGS
Bayou LaFourche	Golden Meadow	7-3813	0.00		59-68		4.7	-1.1			USGS
Bayou LaFourche	Donaldsonville	7-3804	0.00		57-70	273	8.5	3.2	542	0	USGS
Belle River	Near Pierre Pass	52640	0.00		55-70		3.1	-0.3			CE
Pierre Pass	Pierre Pass	52680	0.00		37-53 55-70		4.5	-0.5 3/			CE
Lake Verret	Attakapas Landing	52720	0.00		39-50 55-70		4.5	-0.3 3/			CE
Bayou Boeuf	Amelia	52800	0.00		32-54 55-70		4.5	-2.0 3/,5/			CE
Bayou Black	Gibson	52840	0.00		35-65 68-70		2.8	0.0 3/			CE
Bayou Black	Greenwood	52880	0.00		35-65 66-70		3.1	0.4 3/			CE
Bayou Boeuf (IWW) 1/	Bayou Boeuf Lock (East)	76360	-0.78		54-70		3.8	0.0			CE
Intracoastal Waterway	Houma	76320	-0.78		41-70		4.0	0.2			CE
Bayou Chevreuil	Near Chegby	82525	-0.60		51-70		4.0	-0.4			CE
Bayou Des Allemands	Des Allemands	82700	0.00		50-70		3.3	-0.3			CE
Intracoastal Waterway	Harvey Lock	76200	-0.78		25-70		4.4	-0.5			CE
Intracoastal Waterway	Algiers Lock	76240	-1.00		56-70		5.0	-0.6			CE
Bayou Barataria	Barataria	82750	-0.78		50-70		4.4	0.2			CE
Bayou Barataria	Lafitte	82875	0.00		55-60 63-70		4.0	-0.6 3/			CE
Bayou LaFourche	Leesville	82350	0.00		55-70		5.5	-1.4			CE
Bayou Rigaud	Grand Isle	88400	-4.7		47-70		12.2	3.0			CE
Breton Sound	Near Gardner Island	85850	0.00		57-70		5.7	-3.0			CE
Mississippi River (G.O.) 6/	Near Breton Island	85860	0.00		67-69		4.8	-0.8			CE
Mississippi River (G.O.) 6/	Shell Beach	85800	0.00		48-70		11.1	-2.7			CE
Bayou La Loutre	Alluvial City	85775	0.00		56-70		11.7	-2.6			CE

1/ IWW - Intracoastal Waterway.
2/ Highwater mark.
3/ Intermittent gage record.
4/ Exceeded 6.0 feet (limit of gage).
5/ Lower limit of gage - water below gage.
6/ G.O. - Gulf Outlet.

Low flow frequency curves for stations in WRPA 10 are shown in figures 397 and 398. These curves represent the lowest average flow for periods of 7, 15, 30, and 60 consecutive days. Low flow frequency curves are used in determining the dependable supply of surface water without storage in a stream.

Duration curves for daily flows are presented in figures 399 and 400. The curves indicate the percent of time that any given flow is equaled or exceeded at each site. The occurrence of these flows is not necessarily during consecutive months, but these flows may have occurred at any time during the period of record for the station.

Tables 245 and 246 present data on the dependable yield characteristics at each of the selected discharge sites. These tables show the lowest mean flows for from one to ten consecutive years of the period of record.

Flow Velocities

No time of travel data are available for any of the streams in WRPA 10.

River Profiles

Profiles of the major streams in WRPA 10 are shown in figures 401 and 402. The profiles were constructed from topographic maps and hydrographic surveys. The average annual high water stage was plotted from data for various gaging stations along the river.

HURRICANE OVERFLOW

Figure 403 outlines the areas which would be flooded by the occurrence of a hurricane with a once in 100-year return frequency and a Standard Project Hurricane (SPH). The SPH is defined as a synthetic hurricane which represents the most severe combination of hurricane parameters that is reasonably characteristic of a specified region, excluding extremely rare combinations. The frequency of recurrence for the SPH is dependent on the vulnerability of the location of interest to hurricanes on tracks critical to the area. It is considered to be such a rare event that the assignment of a frequency is inappropriate. Parameters for the SPH, from which hurricanes of other intensities may be derived, have been assigned by the U. S. National Weather Service and mutually agreed upon by representatives of that agency and the Corps of Engineers. The limits of flooding, as shown in figure 403, represent flooding which would be caused by many hurricanes whose tracks would be critical to all areas simultaneously. This was accomplished by transposing the tracks successively along the coast so that each segment of coast in turn would be subjected to maximum flooding from the same intensity hurricane.

Quality

Differences in the chemical composition and dissolved-solids content of water from streams in WRPA 10 are due to the variation in the mineral composition and the relative rates of streamflow and the release of wastes. Variation in specific conductance of Bayou Lafourche at Valentine, La., during the period January to September 1971 is shown in table 247. Because of numerous active oil fields in southern Louisiana, many streams other than Bayou Lafourche may contain wastes, but it is beyond the scope of this study to determine the degree of contamination.

Table 243 - Observed Mean Discharge in c.f.s., Sta 7-3804, Bayou LaFourche at Donaldsonville, La., 1958-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1958	193	288	204	176	150	186	255	284	266	275	258	226	230
1959	273	321	330	318	229	211	257	240	137	187	207	200	244
1960	239	323	272	180	202	234	229	241	264	245	215	212	238
1961	197	304	310	213	196	248	271	291	247	219	228	156	240
1962	297	392	257	227	250	286	315	252	267	380	285	226	286
1963	313	376	337	327	369	320	262	330	309	299	294	252	315
1964	312	315	396	305	325	242	267	324	338	329	320	328	317
1965	366	485	416	303	263	377	287	225	239	297	318	204	315
1966	210	357	352	267	280	265	318	269	250	230	252	227	273
1967	279	454	339	297	337	342	282	299	237	245	205	164	290
1968	333	494	396	268	270	338	224	222	255	218	255	177	288
1969	285	254	240	216	217	184	176	222	275	292	245	243	238
1970	313	401	364	267	163	194	198	365	232	223	284	260	273
Mean	278	366	324	259	250	264	257	274	255	264	259	221	273

Table 244 - Observed Mean Discharge in c.f.s., Sta 7-3750, Tchefuncta River near Folsom, La., 1944-1970

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1944	45	110	160	380	173	297	155	189	82	52	97	98	153
1945	109	249	218	269	257	232	193	121	57	78	112	50	162
1946	136	63	190	353	286	433	85	245	243	285	121	86	211
1947	58	94	179	502	101	542	789	174	134	63	85	82	234
1948	57	293	630	170	279	600	105	85	57	94	91	260	227
1949	57	799	366	168	294	349	353	405	99	302	325	242	313
1950	121	75	99	209	409	424	160	109	128	125	70	110	169
1951	65	58	133	164	395	376	218	64	71	66	52	72	143
1952	48	58	83	64	220	106	157	74	49	54	52	46	83
1953	37	42	76	192	291	232	144	853	69	192	146	50	194
1954	44	87	866	190	98	82	153	60	54	74	52	45	152
1955	56	54	74	185	209	54	201	65	40	44	72	39	90
1956	37	49	74	58	537	264	62	48	90	133	50	49	119
1957	50	44	128	58	100	93	371	50	59	46	53	176	102
1958	90	401	160	194	220	359	155	229	63	111	85	77	178
1959	48	53	54	78	424	110	86	126	373	123	144	61	138
1960	100	99	101	146	249	104	156	75	48	47	144	67	111
1961	46	49	55	206	1,257	493	194	83	69	161	70	161	230
1962	54	800	737	500	114	88	302	85	169	66	60	56	253
1963	106	55	74	106	166	107	51	45	42	73	52	56	77
1964	38	42	67	169	208	570	314	94	55	71	58	41	144
1965	81	92	285	187	357	159	62	47	45	50	66	65	123
1966	40	40	54	296	1,102	262	145	85	71	56	65	49	183
1967	44	45	52	65	143	59	388	247	63	44	45	39	102
1968	37	40	101	151	58	87	85	50	36	37	34	31	62
1969	32	41	209	87	107	244	327	147	42	83	44	37	117
1970	45	40	51	76	93	178	83	71	66	103	51	38	75
Mean	63	142	195	193	302	256	203	145	88	98	85	81	154

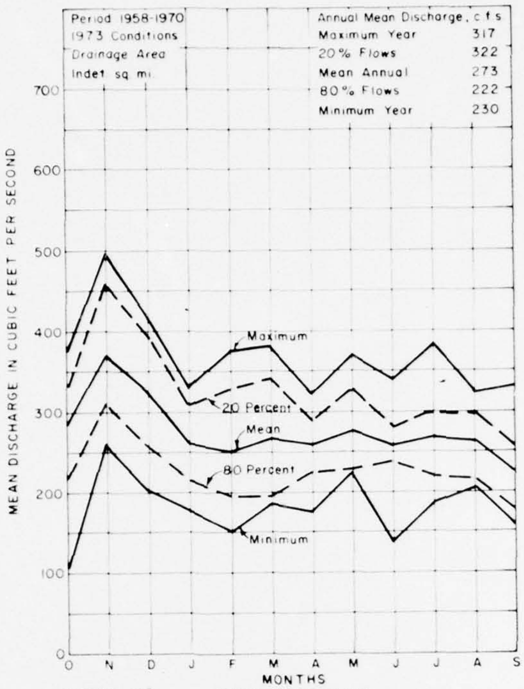


FIGURE 393 MONTHLY DISCHARGE
7-3804 BAYOU LAFOURCHE AT DONALDSONVILLE, LA

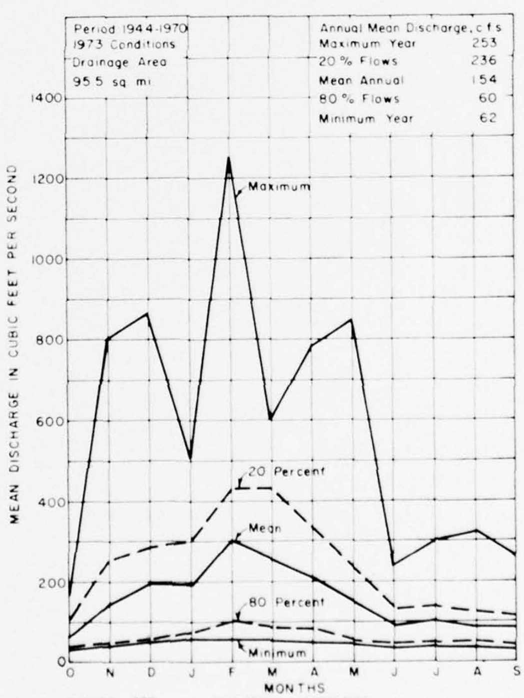


FIGURE 394 MONTHLY DISCHARGE
7-3750 TCHEFUNCTA RIVER NEAR FOLSOM, LA

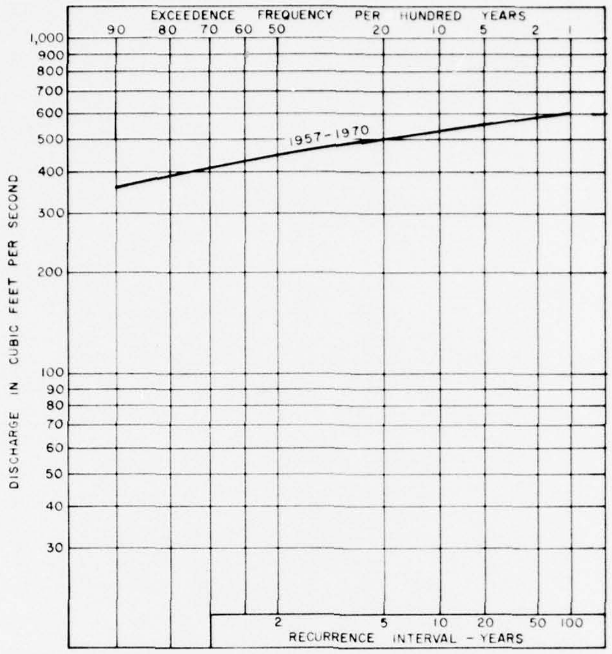


FIGURE 395 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3804 BAYOU LAFOURCHE AT DONALDSONVILLE, LA.

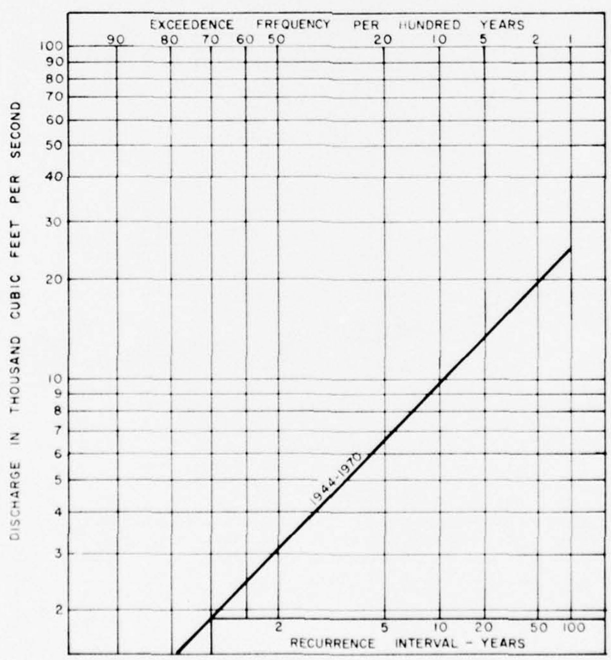


FIGURE 396 FREQUENCY CURVE OF ANNUAL PEAK FLOWS
7-3750 TCHEFUNCTA RIVER NEAR FOLSOM, LA.

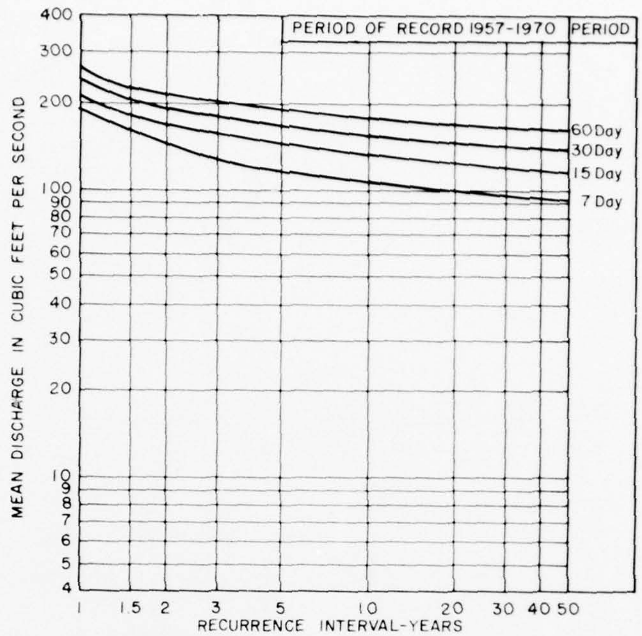


FIGURE 397 LOW FLOW FREQUENCY CURVES
7-3804 BAYOU LAFOURCHE AT DONALDSONVILLE, LA.

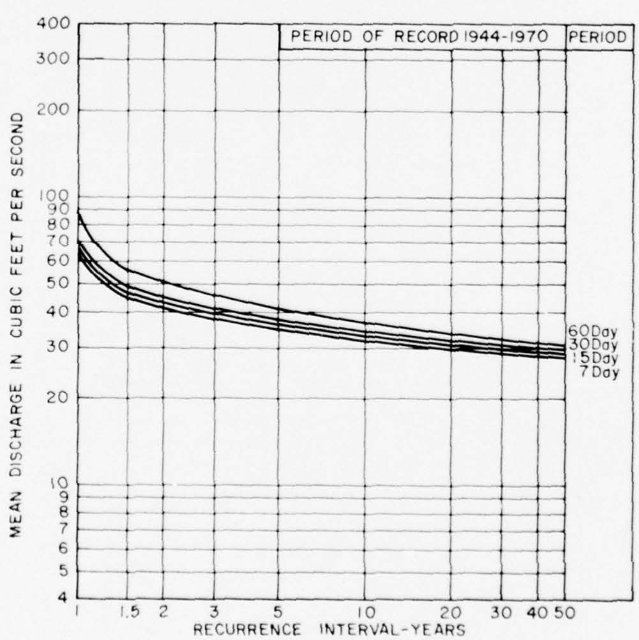


FIGURE 398 LOW FLOW FREQUENCY CURVES
7-3750 TCHEFUNCTA RIVER NEAR FOLSOM, LA.

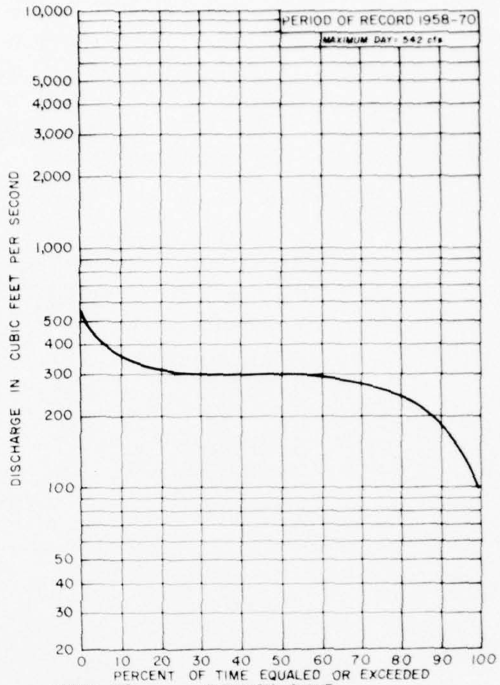


FIGURE 399 DURATION CURVE
7-3804 BAYOU LAFOURCHE AT DONALDSONVILLE, LA

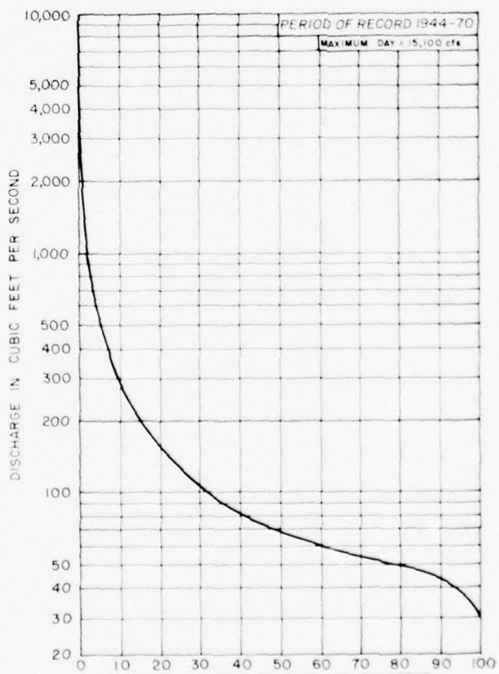


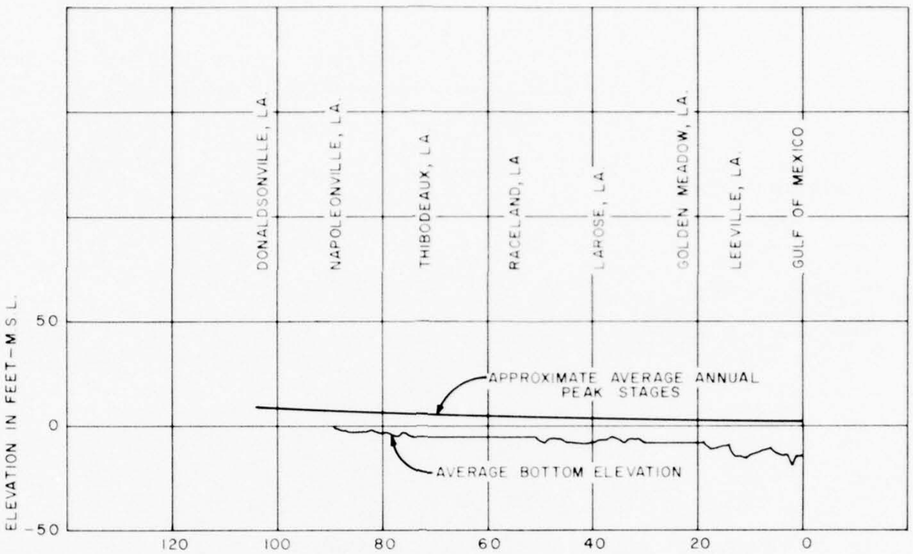
FIGURE 400 DURATION CURVE
7-3750 TCEFUNCTA RIVER NEAR FOLSOM, LA.

Table 245 - Dependable Yield at Sta 7-3804, Bayou LaFourche at Donaldsonville, La.

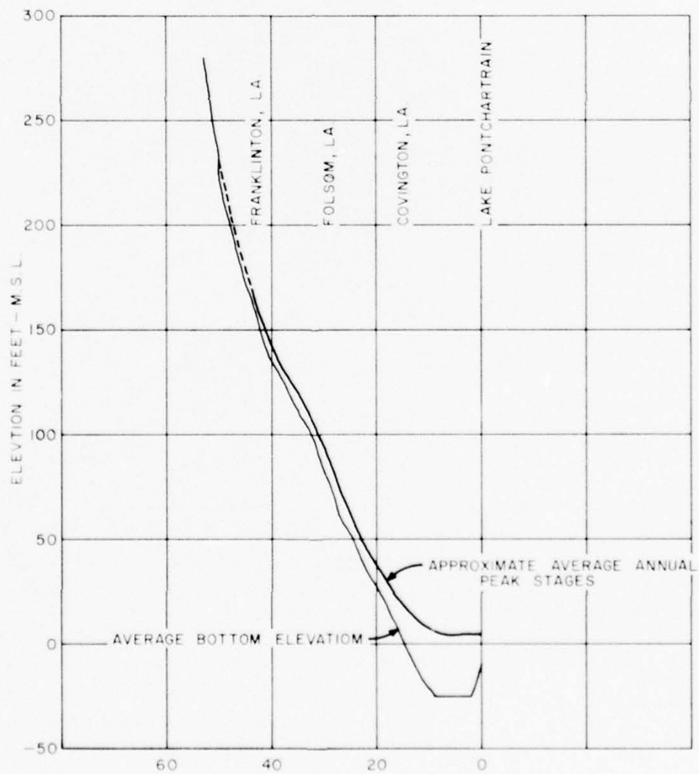
Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1958-1970 Mean
1	1958-1958	230	84.2
2	1958-1959	237	86.8
3	1958-1960	237	86.8
4	1958-1961	244	89.4
5	1958-1962	248	90.8
6	1958-1963	259	94.9
7	1958-1964	267	97.8
8	1958-1965	273	100.0
9	1958-1966	273	100.0
10	1968-1967	275	100.1
13	1958-1970	273	100.0

Table 246 - Dependable Yield at Sta 7-3750, Tchefuncta River near Folsom, La.

Consecutive Years of Lowest Mean Flow	Inclusive Years	Lowest Mean Flow c.f.s.	Percent of 1944-1970 Mean
1	1968-1968	62	40.2
2	1968-1969	90	58.4
3	1968-1970	85	55.2
4	1967-1970	89	57.8
5	1966-1970	108	70.1
6	1965-1970	110	71.4
7	1964-1970	115	74.7
8	1963-1970	110	71.4
9	1962-1970	126	81.8
10	1951-1960	130	84.4
27	1944-1970	154	100.0



DISTANCE IN MILES ABOVE MOUTH OF BAYOU LAFOURCHE
FIGURE 401 STREAM PROFILE, BAYOU LAFOURCHE, LA.



DISTANCE IN MILES ABOVE MOUTH OF TCHEFUNCTA RIVER
FIGURE 402 STREAM PROFILE, TCHEFUNCTA RIVER

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

LIMITS OF HURRICANE OVERFLOW

WRPA 10

FIGURE 403

Table 247 - Specific Conductance (Micromhos at 25° C) of Surface Waters in WRPA 10 in the Lower Mississippi Region, Sta 07381200 Bayou LaFourche at Valentine, La., January 1970 to September 1971

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	--	475	--	341	710	433	366	366	408
2	--	475	--	341	551	441	341	341	408
3	--	450	--	332	525	441	357	332	366
4	--	450	--	341	525	425	366	332	332
5	--	425	--	332	525	416	357	357	307
6	--	400	--	324	525	425	357	366	324
7	454	410	--	307	534	433	357	324	441
8	--	400	--	332	551	408	366	341	425
9	--	400	--	349	542	408	374	366	425
10	--	300	--	357	520	366	391	399	349
11	--	225	--	357	485	357	433	441	332
12	--	250	--	332	458	374	441	374	324
13	--	255	--	341	441	399	433	357	357
14	--	225	--	374	492	416	433	349	408
15	--	215	--	374	525	441	441	324	357
16	--	250	--	391	517	475	458	324	231
17	--	275	--	408	517	467	467	290	280
18	490	300	--	408	534	467	441	231	250
19	--	330	--	408	534	475	441	223	214
20	--	340	--	425	576	475	492	231	185
21	--	--	--	425	593	408	492	240	180
22	--	--	--	425	542	391	483	257	214
23	--	--	--	525	475	441	483	374	225
24	--	--	--	752	483	458	425	140	200
25	440	423	--	725	492	475	366	120	200
26	425	--	--	761	492	467	341	240	205
27	425	--	--	777	458	479	349	366	231
28	425	--	--	626	433	483	357	190	240
29	410	--	--	593	425	399	374	110	240
30	400	00	366	719	408	408	383	170	240
31	420	--	332	--	408	--	374	350	--

GROUND WATER

Fresh ground water is available only in about the northern one-third of WRPA 10 (figure 404). North of Lake Pontchartrain, aquifers of Miocene and Pliocene age contain fresh water as deep as 3,500 feet below mean sea level. The entire area is blanketed by Quaternary deposits and is mostly low lying coastal marshland. The Pleistocene and underlying Miocene and Pliocene deposits comprise a vast thickness of alternating sands and clays. The Miocene and Pliocene deposits are virtually identical lithologically and are generally finer grained than the Pleistocene. Pleistocene deposits underlie the finer grained Holocene alluvium in the Mississippi River Valley and form the most productive part of the Mississippi River Valley alluvial aquifer.

More than 115 mgd of ground water is pumped in WRPA 10. More than half of this amount is withdrawn for industrial purposes, including about 27 mgd of saline water. Most of the remainder is for public supplies, with about 21 mgd pumped for thermoelectric plants. Less than 2 mgd is used for rural domestic and agricultural uses.

Tertiary Aquifers

The Miocene and Pliocene deposits are composed of interbedded sands and clays of varying thickness and contain fresh water in St. Tammany Parish to a maximum depth of about 3,500 feet below sea level. The fine- to medium-grained sands are virtually identical lithologically and are treated as a hydrologic unit, the Mio-Pliocene aquifer, in this report. The sands dip and thicken to the south but do not crop out in the area, as they are overlain by Pleistocene deposits.

Although the individual sands are uniformly graded, they vary considerably in thickness and continuity. Therefore, coefficients of transmissibility vary over a wide range; however, values for major sands are probably on the order of 100,000 to 300,000 gpd per foot. Higher values are possible locally where clays pinch out, and massive sands are formed by the coalescence of two or more sands. Flowing wells yield from a few to more than 3,000 gpm, and yields of several hundred to more than 1,000 gpm are common. Screening the full thickness of massive sands or the multiple screening of several sands could produce even higher yields.

Water in the Mio-Pliocene sands is generally soft, a sodium bicarbonate type where it is fresh, and locally corrosive. Fluoride content varies and locally exceeds recommended limits. Water with a hydrogen sulfide odor also occurs somewhat erratically. Dissolved-solids content increases downdip, and the water becomes a sodium chloride type.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

GEOLOGIC SOURCES OF GROUND WATER

WRPA 10

FIGURE 404

More than 9 mgd is pumped from Mio-Pliocene sands, almost entirely for municipal and industrial use. An estimated additional 15 to 20 mgd flows to waste from uncontrolled wells. Because of the high water levels and large aggregate sand thicknesses, many times the present pumpage is available and pumping lifts are small.

Quaternary Aquifers

Pleistocene Aquifers

Pleistocene deposits overlie the Miocene and Pliocene deposits and also contain fresh water in St. Tammany Parish, most of Orleans Parish, and in the northern parts of Jefferson, St. Charles, and St. John the Baptist Parishes. The Pleistocene aquifer is contiguous with the Mississippi River Valley alluvial aquifer. The Pleistocene aquifer contains interbedded clay as well as some graveliferous sands. The sands have not been completely flushed and contain salty water in the part of the area generally south of New Orleans.

Sands in the Pleistocene aquifer are poorly sorted and range from fine to coarse and graveliferous. Sand thicknesses vary but because of the poor sorting, permeability is limited; coefficients of transmissibility are generally less than 200,000 gpd per foot. Well yields are low to moderate.

Fresh water in the Pleistocene aquifer is generally soft, low in dissolved-solids content, and corrosive in St. Tammany Parish. Along the Mississippi River, the water is soft to moderately hard. Downdip, the water changes to a sodium chloride type.

About 90 mgd presently is being withdrawn from the Pleistocene aquifer. This amount can be increased substantially. Locally, large developments are feasible where the aquifer receives recharge indirectly from the Mississippi River via point-bar deposits. One such area is the vicinity of Norco; water levels quickly stabilize in response to changes in pumpage.

Mississippi River Valley Alluvial Aquifer

The Mississippi River Valley alluvial aquifer is both Holocene and Pleistocene in age. The Holocene alluvium grades finer upward, from fine sands to silts and clays. The underlying Pleistocene is coarser and constitutes the most productive part of the aquifer. The alluvial aquifer is not only contiguous with the Pleistocene aquifer but is in hydraulic contact with the Mississippi River. Because of this large source of direct recharge, the alluvial aquifer is sufficiently distinct to warrant separate discussion.

Wells screened in the Mississippi River Valley alluvial aquifer near the Mississippi River can induce recharge from the river. The

recharge effect of the river decreases with distance from the river.

The chemical quality of water from the Mississippi River Valley alluvial aquifer has been the chief deterrent to increased development of the aquifer. The water is characteristically very hard and high in iron content.

Many times the present pumpage of about 5 mgd can be developed from the Mississippi River Valley alluvial aquifer, and large amounts are available locally for uses that can tolerate the water quality. Well fields can be designed where discharge will be largely induced recharge from the river; such developments can produce large quantities of water with a minimum effect on the rest of the aquifer.

Effects of Ground Water Withdrawals and Management Considerations

WRPA 10 contains more fresh ground water in a smaller area than does any other WRPA. Although several times the present pumpage of good quality water is available, large-scale developments should be planned carefully because of the potential for salt-water encroachment in much of the area. In addition to the normal downdip occurrence of saline water, fresh water is directly underlain by saline water in one of the major Pleistocene Sands. Pumping from the fresh water zone causes upward coning of the underlying saline water, and only controlled developments can produce small to moderate supplies of water of consistently good quality. Saline water bearing sands also occur between fresh water bearing sands in part of the area, which also necessitates particular care in well design, development, and completion.

Water levels, especially in the Mio-Pliocene aquifer, are high and pumping lifts are correspondingly low. Although quite large flowing wells are still obtainable, this condition cannot be expected to last. Regional water level declines caused by pumping and by allowing uncapped wells to flow to waste will eventually lower all water levels below land surface, and wells will cease to flow. Such a change could be considered beneficial from a conservation point of view in that all water withdrawn would be put to use.

Water level declines are not a problem in the Mississippi River Valley alluvial aquifer in areas where direct recharge from the river is available. The water is of poor quality--hard and high in iron content--and varies more in temperature than does most ground water. However, the quantities available at relatively low cost make this aquifer a valuable source of water for some uses.

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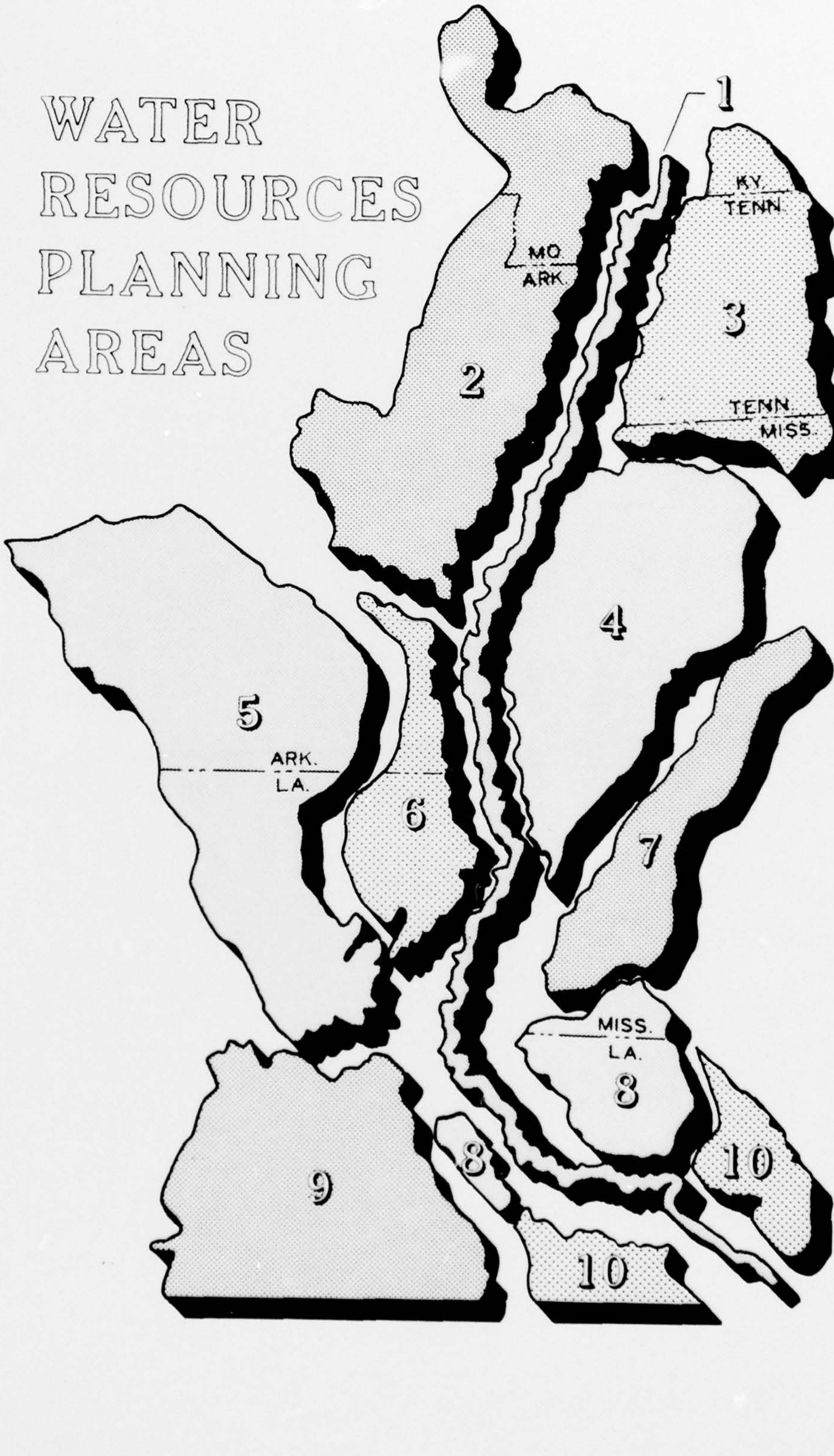
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